JOURNAL OF THE CANADA DEPARTMENT OF AGRICULTURE
JOURNAL DU MINISTÈRE DE L'AGRICULTURE DU CANADA
MINISTER. HON, H. A. OLSON, MINISTRE • DEPUTY MINISTER, S. B. WILLIAMS, SOUS-MINISTRE

Canadian Agriculture Library
Bibliothèque canadienne de l'agriculture
Ottawa K1A 0C5

Do not remove from
Library / Reading Room
Laisser dans la
bibliothèque / salle de lecture

Agriculture and
Agri-Food Canada

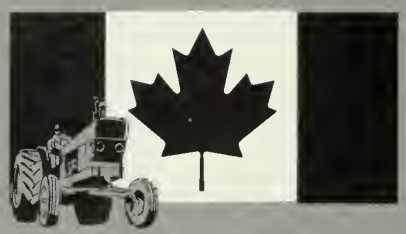
Agriculture et
Agroalimentaire Canada

CANADA AGRICULTURE

WINTER '69 HIVER

COVER PHOTO—
Winter in Ontario.

PHOTO DE COUVERTURE—
L'hiver en Ontario.



"Canada Agriculture" is published quarterly by the Canada Department of Agriculture. Its purpose is to help keep extension workers and agri-businessmen informed of developments in research and other federal agricultural responsibilities as carried on by the various units of the Department.

Contributors, namely, professional personnel in the Department's Research, Economics, Health of Animals, and Production-Marketing Branches, Special Act Administrations (PFRA, etc.), and the Farm Credit Corporation are invited to submit their articles in either English or French.

Contributions should be addressed to the Secretary, Editorial Board, Information Division, Canada Department of Agriculture, Ottawa.

Material appearing in "Canada Agriculture" is public property. Any article may be reproduced with proper identification without special permission, but must not be associated with advertising material. Where excerpts only are to be used, permission of the authors should first be obtained.

The use of trade names in articles published in this journal implies no endorsement of the products named nor any criticism of similar products not mentioned.

«Canada Agriculture», publié par le ministère de l'Agriculture du Canada, paraît tous les trois mois. Ce journal a pour objectif de renseigner sur l'activité des Directions du ministère, les agronomes et les hommes d'affaires intéressés à l'agriculture.

Nos collaborateurs, du personnel professionnel des directions de la recherche, de l'économie de l'hygiène vétérinaire et de la production et des marchés, de l'administration des lois spéciales (ARAP, etc.) du Ministère ainsi que de la Société du crédit agricole peuvent, à leur gré, soumettre des articles en anglais ou en français.

Adresser toute communication au secrétaire du Comité de la rédaction, Division de l'information, ministère de l'Agriculture du Canada, Ottawa.

Les articles qui paraissent dans «Canada Agriculture» sont la propriété du public. Ils peuvent etre reproduits sans permission spéciale à condition d'en indiquer la source mais ne doivent faire partie d'aucune réclame. Lorsqu'on ne cite qu'un extrait il faut d'abord en avoir obtenu la permission de l'auteur.

L'emploi de noms commerciaux dans ces articles ne constitue pas l'approbation du produit nommé, au détriment de produits semblables qui ne sont pas mentionnés.

CANADA AGRICULTURE

JOURNAL OF THE CANADA DEPARTMENT OF AGRICULTURE - OTTAWA
JOURNAL DU MINISTÈRE DE L'AGRICULTURE DU CANADA - OTTAWA
MINISTER, HON. H. A. OLSON, MINISTRE DEPUTY MINISTER, S. B. WILLIAMS, SOUS-MINISTRE

The international dimension of agriculture ... 2
L'agriculture à l'échelon international ... 2
Les hybrides de sorghos comparés à d'autres plantes annuelles ... 9
Breeding potatoes for resistance to wart and golden nematode ... 12
Sex attractant identified in click beetles of the sugar-beet wireworm ... 14
Echo ... 16
Virus disease problems in Ontario fruit orchards and vineyards ... 18
Gardening at Inuvik ... 21
Western encephalitis virus in Alberta ... 24
Champ timothy—development of a high aftermath variety ... 26
Reduce the gamble in wheat production ... 28
Integrated control of fruit tree pests ... 30

VOL. 14 WINTER 1969 No. 1
VOL. 14 HIVER 1969 Nº 1

EDITORIAL BOARD
COMITÉ DE LA RÉDACTION

Chairman, G. M. Carman, Président
K. Rasmussen
C. R. Phillips
R. J. McClenaghan
J. F. Frank
G. P. Boucher
Secretary, C. H. Kenney, Secrétaire

the INTERNATIONAL dimension of agriculture

ROLLAND P. POIRIER

In this concluding chapter, the author deals with two sectors of external aid for developing countries —multilateral and bilateral, discusses some agriculture projects of Canada's External Aid Office, and suggests that a major contribution by Canada to the feeding of mankind could have a big effect on our own agriculture.

A second part of the international dimension of agriculture deals with the external aid for food or agricultural development supplied to developing countries. This new world of external aid can be split up for description into two large sectors. The first sector deals with what we call *multilateral aid*, meaning the aid supplied by international organizations who have to report to many member countries. The second sector is called *bilateral aid* and it describes the aid supplied directly by a developed country to a developing country.

MULTILATERAL AID

Since there is a very large number of organizations in this area, I will restrict myself to the following: FAO, UNDP, World Food Program, World Bank, United Nations and Consortia.

FAO

Although the Food and Agriculture Organization (FAO) was discussed in relation to regular trade in the last issue of CANADA AGRICULTURE, it must also be said that a very large portion of FAO's activities is now directed towards aid to developing countries.

To begin, at FAO's headquarters in Rome there is a very large number of scientists who are recognized world experts in all disciplines dealing directly or indirectly with agriculture. They are called upon constantly to study problems of agricultural de-

Dr. Poirier is Assistant Deputy Minister (Economics), Canada Department of Agriculture, Ottawa, Ont. This article is based on a paper given recently to the Bankers Summer School, University of Guelph.

l'agriculture a l'échelon INTERNATIONAL

ROLLAND P. POIRIER

Dans ce second et dernier article, l'auteur traite des aspects multilatéral et bilatéral de l'aide aux pays en voie de développement, de certains projets agricoles du Bureau de l'Aide Extérieure du Canada et suggère qu'une augmentation considérable de notre contribution aux projets d'alimentation mondiale pourrait avoir une importante répercussion sur notre agriculture.

L'aide fournie aux pays en voie de développement peut se séparer en deux secteurs distincts. Le premier secteur se rapporte à l'aide multilatérale, c'est-à-dire l'aide fournie par des organismes internationaux qui dépendent de plusieurs pays et le second secteur se rapporte à l'aide bilatérale, c'est-à-dire l'aide qui est fournie directement par un pays à un autre.

Dr Poirier est le Sous-ministre adjoint, Ministère de l'Agriculture du Canada. Causerie donnée à l'Association canadienne des manufacturiers de moulées (Est) incorporée à St-Hyacinthe, Qué.

velopment in developing countries. They are often sent to developing countries to take charge of specific studies.

There is, within the organization of the United Nations, a special fund for technical aid and through it FAO can, on short notice, mobilize many experts throughout the 'developed world' and send them on special missions of study in the 'developing world'.

FAO will take under contract, either from the United Nations or from a giving country, certain projects of agricultural development in developing countries.

A few years ago, FAO started a world-wide campaign to publicize the acute problem of feeding mankind. This has been called the Freedom-from-Hunger Campaign and it has been very successful.

In 1966, FAO started a very ambitious survey in relation to the World Food Problem. Called the *Indicative World Plan*, its first purpose is to make a survey as complete as possible of all available food in the different regions of the world and to compare this with the actual and future needs of these regions. The Indicative World Plan wants afterwards to suggest practical and efficient methods of solving the problem of food in all of the deficient regions. This Indicative World Plan should be terminated at the end of 1969 and it will be presented to all countries in a World Congress on Food which will take place in 1970.

Canada has its own organization for the Freedom-from-Hunger Campaign and it also participates in some of the studies related to the Indicative World Plan.

UNDP

The United Nations Development Program (UNDP) corresponds to an organization of the United Nations whose main task is to collect and administer a world fund to activate economic development in developing nations. This fund is used for all sectors of the economic activity but a very large part of the actual project is related directly or indirectly to agriculture. A world conference was held recently in New Delhi, India, to examine policies in relation to fund subscriptions and to a better use of the fund. The developing countries, as a group, were unsuccessful in getting the developed countries to agree on certain trading advantages for their group.

Canada contributed $9.5 million to the UNDP in 1966-67.

WORLD FOOD PROGRAM

The FAO, in collaboration with the United Nations, created in 1962 a food aid program based on contributions made by a certain number of countries. In the month of January 1968, 48 countries promised to subscribe during the period of 1969-70 a total amount of approximately $120 million in currency or in food to subsidize the different projects of the World Food

AIDE MULTILATÉRALE

FAO

Nous avons indiqué dans notre premier article que cet organisme s'occupe du commerce régulier mais aussi de l'aide aux pays en voie de développement.

Disons pour commencer qu'au siège social à Rome, il y a un grand nombre de scientistes connaissant à fond toutes les disciplines agricoles ou para-agricoles. On fait appel constamment à ces experts pour étudier des problèmes se rapportant au développement agricole en pays du tiers monde. Ces experts sont souvent envoyés en pays en voie de développement pour faire des études précises. De plus, grâce, à un fonds spécial des Nations Unies se rapportant à l'aide technique, la FAO engage sous contrat temporaire un grand nombre d'experts, venant d'un peu partout à travers le monde, pour faire des études bien spécifiques dans les pays en voie de développement.

La FAO prend également à sa charge des projets de développement agricole qui sont financés soit par le programme de développement des Nations-Unies, soit par des pays donateurs ou même par des organismes non gouvernementaux.

La FAO a lancé il y a quelques années une grande campagne mondiale dont le but était d'alerter tous les individus au problème très aigu de l'alimentation de tous nos semblables. Il s'agit de la *Campagne contre la Faim* qui a fortement contribué à sensibiliser le monde entier au problème primordial de notre temps qui consiste à mieux alimenter une population mondiale qui prend des proportions inquiétantes.

La FAO a lancé il y a deux ans une étude de grande envergure se rapportant au problème mondial de l'alimentation humaine. Il s'agit du Plan Indicatif Mondial qui a pour but de faire un recensement le plus exact possible de toutes les disponibilités dans le domaine de la production agricole à travers le monde et de comparer ces disponibilités aux besoins actuels et futurs des différentes régions. Le Plan Indicatif Mondial doit ensuite suggérer des méthodes pratiques pour voir à ce que les régions sous-alimentées solutionnent dans un avenir rapproché leur problème d'alimentation. Ce Plan Indicatif Mondial sera probablement terminé au début de l'année 1969 et on veut alors le présenter à tous les pays du monde lors d'un congrès mondial de l'alimentation.

UNDP

Ce sigle veut dire *United Nations Development Program* et il s'agit d'un organisme qui voit à recueillir et à administrer un fonds mondial devant servir à activer le développement économique dans les pays en voie de développement. Ces fonds s'appliquent à tous les secteurs de l'activité économique mais une bonne partie des projets se rapportent directement ou indirectement à l'agriculture.

Program. Under this program, quantities of food are supplied to developing countries provided that this food will serve as an integral part of a project of economic development or to help in disaster areas.

Canada has just promised a subscription of $22 million to the World Food Program for 1969 and 1970. A very large portion of this amount will be given directly as food. Thus Canada becomes the second most important contributor to this Program after the U.S.A. Most of the activities relating to the World Food Program in Canada are coordinated by the federal Department of Agriculture.

WORLD BANK (IBRD)

The International Bank for Reconstruction and Development, better known as the World Bank, is one of the specialized agencies related to the United Nations.

The Bank has three sectors of activity: (1) Primarily it lends money to developing countries at rates of interest somewhat comparable to that of other banks but on longer-term basis; (2) through a subsidiary called the International Development Association (IDA), it lends money almost without interest to the poorer developing countries; and (3) through the International Finance Corporation, it lends money exclusively to the private sector of the economy or buys stocks from private companies.

The funds necessary for the operation of the World Bank are subscribed as advances by the member countries of the United Nations. In 1966-67, Canada made advances for the regular operation of the Bank up to an amount of $4½ million. Canada has also subscribed $15 million for the operation of the International Development Association.

It is quite interesting to note that the World Bank is more and more interested in projects dealing with agricultural development and actually about 20% of its loans are in that category. In the future, they want to increase this portion of their investments.

On a tenu tout récemment une conférence mondiale à New Delhi, aux Indes, afin d'examiner les problèmes se rapportant à une meilleure utilisation de ce fonds d'aide. Cette conférence s'est soldée par un échec partiel puisque l'ensemble des pays en voie de développement n'a pas pu obtenir des pays développés un certain nombre d'avantages commerciaux qui auraient aidé considérablement leur développement économique.

Le Canada en 1966-67 a contribué $9,500,000 aux fonds UNDP.

PROGRAMME ALIMENTAIRE MONDIAL

La FAO en collaboration avec les Nations Unies a créé en 1962 un programme d'aide alimentaire dont les fonds sont obtenus grâce à des subventions fournies par un certain nombre de pays. Au mois de janvier de cette année, 48 pays ont promis de verser sur une période de deux ans un montant d'environ 120 millions de dollars en argent ou en espèces, devant servir aux différents projets relevant du Programme Alimentaire Mondial. Selon ce programme, des quantités d'aliments sont fournies à des pays en voie de développement à condition cependant que ces aliments fassent partie d'un projet de développement économique.

Le Canada vient de s'engager à fournir au Programme Alimentaire Mondial la somme de 21 millions de dollars pour les années 1969 et 1970. Le Canada devient donc le contributeur le plus important à ce Programme après les États-Unis. La plupart des activités se rapportant à ce Programme Alimentaire Mondial sont coordonnées au Canada par le ministère fédéral de l'Agriculture.

BANQUE MONDIALE—IBRD

La Banque Internationale pour la Reconstruction et le Développement est un des principaux organismes relevant des Nations Unies. Cette banque voit à faire les prêts d'argent nécessaires pour financer les projets de développement dans les pays du tiers monde. Elle le fait ordinairement sur une base d'affaires mais elle permet des méthodes de remboursement qui sont beaucoup plus faciles que celles des banques ordinaires. La Banque Mondiale par le truchement d'une institution subsidiaire, l'Association de Développement International fournit également aux pays les plus pauvres des prêts à long terme sans intérêt. Les fonds nécessaires pour financer cette banque sont fournis par les différents pays faisant partie des Nations Unies. Il est intéressant de noter que la Banque Mondiale s'intéresse de plus en plus aux projets se rapportant au développement agricole et actuellement environ 20% des fonds sont fournis à cette fin.

Il s'est formé depuis quelques années un certain nombre de banques régionales qui opèrent sur les mêmes principes que la Banque Mondiale. Il y a

In the last few years, a number of regional banks have been organized on the same principle as the World Bank and Canada has made some advances in money to some of them.

The World Bank and the regional banks are presently the best organizations to make an efficient and realistic study of projects dealing with agricultural development. Furthermore, once a bank has agreed to make a loan for a particular project, it follows the development of the project and it suggests corrective action when necessary.

UNITED NATIONS

The General Assembly of the United Nations will in certain circumstances deal directly with certain problems of economic development and will subsequently create a temporary or permanent organization to deal with these special problems. The UN General Assembly, at the beginning of 1968, inaugurated an important campaign to promote an increase in the production of protein throughout the world to improve the level of nutrition in developing countries. A general survey is under way in as many countries as possible to appraise the different national programs of production and also to calculate the exact need in deficient countries. This enquiry is expected to be finished in 1968 and may be followed by a world program of increased production of proteins. Canada has agreed to participate in this campaign and the work will be coordinated by the Canada Department of Agriculture.

CONSORTIA

In certain developing countries and in particular regions, it is often necessary to coordinate all aid supplied by different nations or by different international organizations. This is done through a voluntary coordinating unit which is usually called a consortium. The consortium is started either by the World Bank, the FAO or a particular country and it becomes a center of study and information where the different efforts are coordinated. Such consortia already exist for India, Tunisia and certain parts of Latin America. Canada is a member of some of these consortia.

actuellement un tel organisme pour l'Amérique du Sud, pour l'Afrique et pour l'Asie.

La Banque Mondiale ou les banques régionales constituent actuellement à peu près les meilleurs organismes pour faire une étude réaliste des projets de développement économique dans le tiers monde. De plus, une fois que la banque a fourni des fonds pour un projet particulier, elle suit la réalisation du projet, elle juge ses résultats et elle suggère les correctifs nécessaires.

Pour l'année 1966-67, le Canada a versé à la Banque Mondiale des avances pour un montant de $4,500,000. Le Canada a également fait des avances pour un montant de 15 millions de dollars se rapportant aux activités de l'Association de développement international.

LES NATIONS UNIES

L'assemblée générale des Nations Unies peut en certaines circonstances s'intéresser directement à des problèmes de développement économique et elle crée alors un organisme temporaire ou permanent pour s'occuper de ces problèmes spéciaux. L'assemblée générale des Nations Unies vient de lancer au début de la présente année une campagne importante pour promouvoir l'augmentation des sources de protéines à travers le monde pour améliorer l'alimentation surtout dans les pays en voie de développement. On a lancé une enquête générale dans le plus grand nombre de pays possible pour connaître les programmes nationaux dans ce domaine et pour connaître aussi les besoins des pays déficitaires. Cette enquête sera terminée cette année même.

CONSORTIA

Dans des pays importants ou dans des régions particulières, il est souvent nécessaire de coordonner l'aide fournie par plusieurs pays développés grâce à un organisme que l'on appelle un consortium. Le consortium se crée soit à l'instigation de la Banque Mondiale, soit à l'instigation de la FAO ou d'un pays en particulier et il devient un centre d'étude et d'information où se rencontrent les principaux pays donateurs afin de coordonner leurs efforts. Un tel consortium existe déjà pour l'Inde, la Tunisie et pour certaines régions de l'Amérique du Sud.

Dr. B.R. Sen, former Director-General of FAO, and Dr. Poirier at the 1967 FAO Conference.

Dr. B.R. Sen, ancien directeur général de la FAO, et le Dr. Poirier au cours de la conférence de la FAO en 1967.

BILATERAL AID

In spite of valuable work done by international groups to solve the problems of aid to developing countries, it must be admitted that the multilateral method has limitations. Most of the developing countries have decided to offer a larger proportion of their external aid directly to developing nations and this is what we call *bilateral aid*. In Canada presently, it can be said that about 80% of the money for external aid is given directly to developing nations.

Canada's bilateral aid is handled by the External Aid Office, a federal agency that comes under the Secretary of State for External Affairs.

For the year 1966-67, Canada spent $145 million in bilateral aid and only $28 million in multilateral aid. Furthermore, Canada has made loans amounting to $50 million directly to developing countries and has supplied some $22 million as advances to international loan agencies.

Out of the $145 million spent as grants for bilateral aid, $87 million have been used for food aid. The food aid went mainly to India and Pakistan and a small part to Ceylon. If we examine the other $58 million which went for bilateral aid other than food aid, we find that a very small part of this amount was spent on projects of an agricultural nature.

An examination of the different kinds of external aid that Canada supplied to the developing countries during 1966-67 reveals:

(a) We must repeat here that a very large part of this aid has been food aid to India and Pakistan.

(b) Canada has sent to developing countries a good number of scientific and technical advisers for the different sectors of the economic activity. Agriculture has received a small part of these advisers but we must say that the number of agricultural advisers is steadily increasing from one year to the next.

(c) In 1966, Canada sent 824 persons to teach for

AIDE BILATÉRALE

Malgré tous les efforts fort louables que l'on fait au niveau des groupes internationaux pour solutionner les problèmes de l'aide donnée aux pays en voie de développement, on s'aperçoit que cette méthode multilatérale comporte de nombreux inconvénients. Les principaux pays développés préfèrent donc donner une bonne partie de leur aide directement et c'est ce qu'on appelle l'aide bilatérale. C'est ainsi que le Canada dispose de plus de 80% des argents dépensés pour l'aide aux pays en voie de développement.

Le Canada a établi une agence spéciale pour s'occuper de l'aide bilatérale. Il s'agit du Bureau de l'Aide Extérieure. Cette agence relève directement du Secrétaire d'État aux Affaires Extérieures.

Disons pour commencer que pour l'année 1966-1967, le Canada a dépensé en subventions environ 145 millions pour l'aide bilatérale et seulement 28 millions pour l'aide multilatérale. Il a de plus fait des prêts pour un montant de 50 millions d'une façon bilatérale et il a fourni environ 22 millions comme avances aux agences multilatérales pour des prêts.

Du montant de subventions de 145 millions pour l'aide bilatérale, il y a un montant d'environ 87 millions de dollars qui est allé à l'aide alimentaire. Cette aide alimentaire a été fournie à l'Inde, au Pakistan et au Ceylan. Si l'on fait abstraction de cette aide alimentaire, on constate qu'une très petite partie des montants dépenses pour l'aide bilatérale est allée a des projets d'ordre agricole.

Voyons maintenant comment le Canada aide directement les pays en voie de développement:

a) Il offre une aide alimentaire considérable et ceci surtout aux Indes et au Pakistan.

b) Le Canada fournit aux pays en voie de développement des conseillers scientifiques et techniques pour plusieurs secteurs de l'activité économique. Jusqu'à présent la part de l'agriculture dans ce secteur a été plus ou moins limitée. Cependant on doit dire que les conseillers techniques se rapportant à l'agriculture augmentent constamment en nombre et on prévoit que cette augmentation se continuera.

c) Le Canada envoie du personnel enseignant pour tous les niveaux d'éducation des pays en voie de développement. Là encore la part de l'agriculture a toujours été assez restreinte. En 1966, le Canada a envoyé 824 enseignants dans les pays en voie de développement.

d) Le Canada reçoit au pays un grand nombre d'étudiants venant des pays en voie de développement. Il défraie toutes les dépenses se rapportant à la formation de ces étudiants étrangers. A la fin de 1966, il y avait au Canada 2,200 étudiants et stagiaires et ils venaient de 67 pays différents. La part de l'agriculture dans ce domaine est plus ou moins impor-

all levels in the developing countries. Only a very small part of this group were specialists in agriculture.

(d) Canada has received a large number of students from developing countries and has paid all expenses incurred by these foreign students. At the end of 1966, there were in Canada 2,200 students and trainees and these came from 67 different countries. The part of agriculture here again is rather limited; in 1966 only 146 students and trainees were in agriculture.

(e) Canada has invested in equipment and in capital goods in the developing countries. A part of these investments was in the form of long-term loans and another was made on a pure grant basis. In this field of equipment and capital goods, the hydroelectric sector has had by far the largest share.

SOME EXTERNAL AID OFFICE AGRICULTURE PROJECTS

What are some of the recent studies or projects of Canada's External Aid dealing with agriculture? Consider the following:

West Indies.—There is a project to establish Canadian dairy cattle on the islands of Trinidad and Barbados. Recently, two scientists went to Jamaica to study some problems associated with the preservation of fruits and the production of spices. There is a small project for the control of mosquitoes in the Cayman Islands. Finally, an expert was sent recently to Jamaica to study a program of tobacco production.

Ghana.—Two Canadian veterinarians have been sent to Ghana to help in disease eradication. We also have one Canadian scientist helping in the establishment of a control laboratory for the quality of food. Finally, since 1965, the federal Department of Agriculture has lent 13 experts to Ghana to work on some projects of water control.

India.—In the Fall of 1967, we sent a task force to India to study the different fields of agriculture where Canada would have the necessary resources to help India. This task force submitted its report to the External Aid Office in the Spring of 1968.

Korea.—Canada has concluded an agreement with Korea and a long-term loan will enable this country to establish a certain number of dairy herds based on Canadian cattle.

Kenya.—Three of our Canadian scientists have been loaned to Kenya to help them in their program of wheat breeding at their Research Station in Njoro. One Canadian economist is also serving the Ministry of Agriculture of that country. Finally, a survey team of five persons has just arrived from this country where they have examined projects for the increased production of wheat in Kenya.

Tanzania.—A part of the enquiry team that has gone to Kenya went also to Tanzania to examine another project in wheat production.

Togo.—We recently sent two Canadian experts in animal husbandry to Togo to judge a project dealing with the establishment of a ranch for beef cattle.

tante. En effet, en 1966 il y avait au Canada 146 étudiants et stagiaires agricoles.

e) Le Canada fournit des investissements en équipement ou en immobilisations aux pays en voie de développement. Une partie de ces investissements se fait sous la forme de prêts à long terme mais une autre partie consiste en un don pur et simple. Dans le domaine de l'équipement et de l'immobilisation, c'est surtout le secteur hydroélectrique qui a eu la prédominance jusqu'à présent.

QUELUQES PROJETS AGRICOLES DU BUREAU DE L'AIDE EXTÉRIEURE

Indes Occidentales.—Dans la région des Indes Occidentales, il y a présentement un projet tentant à établir des bovins laitiers sur l'île de Trinidad et aux Barbades. En Jamaïque, nous avons prêté les services de deux scientistes pour étudier des problèmes se rapportant à la préservation des fruits et à la production des épices. Nous avons envoyé un expert en extension agricole en Guinée mais ce projet n'a pas eu de suite. Il y a un projet de recherche pour le contrôle des moustiques dans les Îles Cayman. En Jamaïque nous avons envoyé un membre de la Station de Recherche de Delhi, M. Elliott, pour étudier un programme de production de tabac.

Ghana.—Au Ghana, nous avons un projet d'aide en médecine vétérinaire qui emploie deux Canadiens. Nous avons également un scientiste canadien qui aide à établir un laboratoire pour le contrôle de la qualité des aliments. Enfin depuis 1965, le ministre Fédéral de l'Agriculture a prêté de 10 à 15 experts pour entreprendre des projets hydrologiques.

Indes.—Nous venons d'envoyer, l'automne dernier, une commission d'étude aux Indes, commission qui vient de remettre son rapport au sujet du genre d'aide que le Canada devrait offrir à ce pays.

Corée.—Le Canada vient de conclure une entente avec la Corée au sujet d'un prêt à long terme qui permettra à ce pays d'établir des troupeaux de bovins laitiers en se basant sur des vaches Holstein canadiennes.

Kenya.—Au Kenya, nous avons déjà trois scientistes qui ont été prêtés à la Station de Recherche de Njoro, dans le but d'établir un programme d'amélioration génétique du blé pour ce pays. Nous avons également prêté les services d'un économiste canadien. Enfin il y a une commission d'enquête qui vient d'arriver dans ce pays pour examiner un projet de production de blé dans une certaine région du Kenya.

Tanzanie.—Une partie du personnel de la commission d'enquête du Kenya se rendra ensuite en Tanzanie pour examiner un projet de production de blé pour ce pays.

Togo.—Nous avons envoyé deux experts en zootechnie au Togo pour étudier un projet de ranch pour les bovins de boucherie.

Maroc.—Nous avons envoyé récemment une mission au Maroc pour étudier un projet de développement agricole dans la région du Rif Occidental.

Morocco.—A Canadian mission has just returned from Morocco where they studied a project of agricultural development in the region of West RIF.

Thailand.—The University of Alberta has sent a certain number of Canadian professors to help in the establishment and development of the Faculty of Agriculture of the University of Khonkaen in Thailand.

The Canada Department of Agriculture collaborates with the External Aid Office on all projects of external aid dealing with agriculture. It has recently set up a unit headed by Mr. T. G. Willis in order to offer the External Aid Office scientific and technical expertise necessary for the appraisal and implementation of projects dealing with agricultural development in developing countries.

A MAJOR CONTRIBUTION BY CANADA TO THE FEEDING OF MANKIND COULD HAVE A LARGE EFFECT ON OUR AGRICULTURE

All of us Canadians should take an active part in the solution of the major problem of feeding mankind. We should do it for many good reasons and I want to mention three of them.

Our first motive should be of very high order. It can be summarized by saying that, fundamentally, we recognize all members of the human race as being equal brothers, possessing a certain number of basic rights, one of which is to be fed adequately.

The second motive deals with our personal protection. This we know because it will be impossible to forever keep our present privileges of wealth if a large proportion of our brothers of different color and nationality continue to suffer from hunger.

Finally, the third motive is one that deals with national interest. I think, by considerably increasing our participation in projects of food aid and agricultural aid, that we could establish conditions for agriculture analogous to those that we knew during World War II when surpluses in agricultural production were non-existent. This would lead to better prices of farm products and could get the agricultural sector out of the depressed situation in which it has been struggling for many years.

Furthermore, a more intense participation in solving the world food problem would certainly increase our stature in all international forums and help Canada considerably in becoming better known throughout the world. What better way for finding new customers not only in developed countries but also in developing countries where we may find buyers for some of our products in the very near future?

Solving the problem of feeding the world is a tremendous venture which can mobilize as much of our energy as fighting a world war. I am sure that if we attack it in the right way and if we give it enough priority, it will be an excellent way of bringing unity between all members of our own country. ■

Thaïlande.—Enfin à l'Université Khonkaen du Thaïlande, nous avons un certain nombre de professeurs canadiens venant de l'Université de l'Alberta. Ils ont contribué à l'établissement et au développement du secteur agricole de cette université.

CONSÉQUENCES SUR L'AGRICULTURE CANADIENNE, DU DÉBLOCAGE DE LA QUESTION DE L'ALIMENTATION MONDIALE

Je crois que nous devons tous, comme Canadiens, nous attaquer résolument à la solution du problème de l'alimentation mondiale. Nous devons le faire pour un grand nombre de motifs et je veux ici en mentionner trois par ordre d'importance.

Le premier motif est d'ordre strictement humanitaire et c'est celui qui reconnaît que l'espèce humaine est constituée d'un groupe de frères égaux en principe et qui possèdent tous un certain nombre de droits fondamentaux dont l'un des premiers est celui d'être alimenté convenablement.

Le deuxième motif en est un de protection personnelle puisqu'il sera impossible demain de conserver nos privilèges actuels si une trop grande proportion de l'humanité continue de souffrir de la faim.

Enfin nous devrions avoir un troisième motif qui, lui aussi, relève de l'intérêt personnel, du moins pour tous ceux qui participent au Canada au vaste secteur de l'alimentation humaine. Je m'explique au sujet de ce troisième motif.

Je crois que nous pourrions, en augmentant considérablement notre participation à des projets d'alimentation mondiale, répéter pour notre agriculture des conditions analogues à celles que nous avons connues pendant la guerre. Nous pourrions remplacer des surplus perpétuels dans notre agriculture par un équilibre entre l'offre et la demande grâce au transfert d'aliments vers les régions déficitaires. Même si nous ne visons pas à enrichir ainsi nos cultivateurs, il est impossible qu'un rétablissement d'équilibre entre l'offre et la demande n'apporte pas un affermissement de tous nos prix agricoles.

Enfin, nous ne pourrions pas participer sérieusement à de tels projets sans intensifier considérablement notre présence dans toutes les assemblées internationales. Cette nouvelle ouverture envers tous les pays du monde ne pourrait à la longue qu'intensifier notre commerce international dans tous les secteurs de l'économie. Je crois même que nous trouverions bientôt des clients commerciaux pour certains produits dans les pays en voie de développement.

Ce serait réellement réconfortant pour un professionnel de l'agriculture de passer, petit à petit, de la présente époque où notre secteur de l'économie est sous-estimé et déprimé vers une autre période où notre rôle prendrait petit à petit sa valeur réelle devant l'opinion publique. Valoriser la nécessité des aliments dans le monde, c'est valoriser en même temps l'agriculture et ceux qui s'y rattachent. Espérons que nous nous dirigeons dans cette direction. ■

Maïs Algonquin—Population 200,000 à l'hectare (80,000 l'acre)—Semé le 1er juin 65—Photo Septembre 1965.

LES HYBRIDES DE SORGHOS COMPARÉS À D'AUTRES PLANTES ANNUELLES

3 ANNÉES D'EXPÉRIMENTATION DANS LES RÉGIONS DE MONTRÉAL ET DES CANTONS DE L'EST

H. GASSER

Une des principales cultures des pionniers du sud des États-Unis a été le sorgho fourrager. Des variétés hybrides ayant comme parents, soit deux sorghos, ou un sorgho croisé à un sudangrass ont été récemment obtenues. Certains de ces hybrides ont révélé une vigueur accrue qui leur permet d'être cultivés même au Canada.

Le sorgho, le sudangrass et plusieurs autres types de sorgho appartiennent à la même espèce, *Sorghum vulgare* Pers. Introduits en Amérique depuis plus d'un siècle, ils sont classifiés d'après l'usage qu'on en fait. Ainsi, on cultive le sorgho à grain, le sorgho à sirop, le sorgho à balai et le sorgho fourrager.

Les essais de sorgho fourrager comme plantes fourragères de secours sont récents, comparés à ceux des plantes fourragères annuelles.

Dans les régions de Montréal et des Cantons de l'Est, au cours des années 1964-67, on a étudié plusieurs sortes de plantes annuelles en même temps que les sorghos et leurs hybrides pour déterminer si ceux-ci pouvaient être cultivés avec succès. Voici les résultats de ces études.

DISPOSITIF ET PROCÉDURE EXPÉRIMENTALE

Deux régies ont été adoptées pour le processus expérimental des essais à Lennoxville et au Collège Macdonald: une régie simulée d'affouragement en vert et une d'ensilage. Pour la première, on récoltait deux fois au stade de la montaison et pour la deuxième, une fois en fin de saison, au stade laiteux-mou comme pour l'ensilage. Au collège Macdonald, des semis pour l'évaluation des rendements à l'ensilage ont été faits en 1964, 65, 66, et 67 et on y a semé deux essais en 67 pour évaluer les rendements de fourrage vert.

A Lennoxville le programme de recherches a commencé en 1965; en 65, 66 et 67, on a ensemencé chaque année un essai combiné pour évaluer les rendements en ensilage et la meilleure date de semis.

RÉSULTATS DES ESSAIS

Fourrage frais. Au collège Macdonald—Les essais récoltés comme fourrage frais simulé en 1967 sont rapportés au tableau 1. Deux essais qui se trouvaient en 67 dans deux champs différents nous ont permis d'arriver à une première appréciation du comportement des sorghos hybrides en regard du millet japonais. Il semble assez évident d'après les rendements obtenus que le millet japonais a produit moins de matière sèche que les sorghos hybrides. En mettant la production du millet japonais à 100%, les rendements moyens de sorghos hybrides ont varié de 105% à 131.71%. Il semble bien que les variétés Sordan, Haygrazer, Sughum-50, R.P. Mor-Su et FFR-66 sont de bonnes variétés pour la région de Montréal.

À Lennoxville—Dans la région des Cantons de l'Est, le travail fait à la Station de recherches de Lennoxville de 1965 à 1967 a fourni des données

Dr. Gasser est un spécialiste en physiologie et écologie (légumineuses et plantes annuelles), Station de recherches, Lennoxville, Québec. Cet article a été écrit par Jean Baroux de la Division de l'information, en collaboration avec le docteur H. Gasser.

qui permettent d'arriver à des conclusions valables. On a évalué 21 sorghos hybrides, une variété de sudangrass, une variété de sorgho (Sugar-Cane), trois millets et une variété d'avoine.

Le tableau 2 montre les différences de rendements entre la première et la deuxième coupe et aussi d'une année à l'autre. En première année, les rendements étaient moindres que ceux de 66 et 67. La saison 65 était plus froide que la normale ce qui expliquerait la différence des rendements et même la différence entre les coupes.

La performance de rendements par coupes, des variétés de sorghos hybrides des millets et autres, est présentée au tableau 3. Les variétés à l'essai ont été classées en trois groupes. Le premier comprend le meilleur choix pour les Cantons de l'Est, le deuxième est un choix intermédiaire si les variétés du premier groupe ne sont pas disponibles et le troisième comprend des variétés qui ne devraient pas être recommandées sous nos conditions.

Ces trois années d'essais ont démontré assez clairement que le millet japonais peu produire plus de matière sèche que l'avoine avec une régie d'affouragement frais, et aussi plus que n'importe quel sorghos hybrides 3658 kg/ha comparé à 3000 kg/ha ou moins. L'avoine n'a été guère meilleure que plusieurs des variétés de sorghos hybrides que nous trouvons sur le marché.

Ensilage. Au Collège Macdonald—Six individus parmi les sorghos hybrides, millet et avoine évalués au Collège Macdonald, ont été analysés et leurs rendements en matière sèche se trouvent au tableau 4. L'année 1967 a vu les rendements s'améliorer considérablement puisque la moyenne des individus évalués a été de plus de 5000 kg plus élevée que celles des années précédentes. On peut aussi remarquer une différence très nette entre les variétés Funks 77F, Sudax et toutes les autres variétés.

Il n'y a pas eu de différences significatives entre les variétés de sorghos hybrides Funks 92F, R.P. Mor-Su, et la variété de maïs Algonquin.

À Lennoxville—Semées à quatre dates différentes, les cinq variétés de sorghos hybrides éprouvées se sont comportées comme le millet japonais et le millet hongrois (table 5). Le maïs semé à haute densité a donné des rendements de matière sèche significativement supérieurs aux sorghos hybrides et aux millets.

L'analyse qui a été faite a aussi démontré une différence marquante entre chaque date de semis. Il ressort très nettement qu'un semis fait au début juin donne des rendements maximum tandis qu'un semis du début juillet ne peut pas donner de rendements élevés en matière sèche. Les années d'essais ont donné des résultats différents significativement les uns des autres; 1967 ayant été la meilleure et 1965 la pire, au point de vue rendement. Il est à noter qu'en fin du mois d'août, les unités de chaleurs à la base 42°F ont été de 2372 en 67, 2355 en 66 et 2300 en 65.

LES SORGHOS HYBRIDES

Il est incontestable que les sorghos hybrides, tels le Funks 92F et le R.P. Mor-Su, peuvent donner autant de rendement que le maïs Algonquin dans la région de Montréal. Nous pouvons aussi nous hazarder à dire que dans la région de Montréal certaines variétés de sorghos hybrides peuvent être semées aussi avantageusement que le millet japonais pour une récolte de deux coupes de fourrage utilisables en fourrage vert.

Trois ans de travail, à la Station de Recherches de Lennoxville, prouvent que le millet japonais est encore la plante la plus profitable pour être affouragée frais à raison de deux coupes par saison, et que l'avoine n'est guère supérieure en rendement à plusieurs des 21 variétés de sorghos hybrides éprouvées. On peut aussi se permettre de faire une extrapolation de ces résultats et recommander que, tant que des sorghos hybrides plus hâtifs que ceux éprouvés n'arriveront pas sur le marché, il est mieux de se fier au millet japonais dans les Cantons de l'Est pour du fourrage de secours, i.e. à être affouragé frais. À défaut du millet japonais, certaines variétés de sorghos hybrides peuvent produire autant de fourrage que l'avoine.

Les résultats de 1965 ont laissé entrevoir que le maïs semé à la densité conventionnelle n'est guère supérieur au millet japonais, ni au sorghos hybrides. Mais d'après les rendements élevés du maïs à haute densité, nous pouvons le recommander pour l'ensilage avant tout autre espèce.

Le travail de Lennoxville a aussi démontré que les semis au début de juin ont donné les meilleurs résultats et que les recommandations faites ne sont valables que si les semis sont faits aussi près que possible de cette date. ■

TABLEAU 1. RENDEMENTS EN MATIÈRE SÈCHE D'HYBRIDES DE SORGHOS RÉCOLTÉS À LA MONTAISON ET COMPARÉS AU MILLET JAPONAIS (kg/ha). COLLÈGE MACDONALD 1967.

	Champ 501	Champ 319	Moyenne
Millet japonais	7919 d[1]	4873 c	6406
Sordan	9595 a	7071 a	8333
Haygrazer	9752 a	6389 ab	8070
Sughum-50	9881 a	5947 abc	7914
R.P. Mor-Su	9510 a	6091 abc	7800
FFR 66	9132 ab	6079 abc	7605
HW 8029	8893 abc	5610 bc	7251
Trudan II	8234 bcd	5944 abc	7089
Funks 77F	8299 dcd	5565 bc	6932
Sudax	8078 cd	5351 bc	6714

[1] Les rendements n'ayant pas la ou les mêmes lettres diffèrent.

TABLE 3. PERFORMANCE DE SORGHOS HYBRIDES ET D'AUTRES PLANTES FOURRAGÈRES ANNUELLES. RENDEMENTS MOYENS PONDÉRÉS EN kg/ha PAR COUPE. LENNOXVILLE 1965-1967.

Groupe I		Groupe II		Groupe III	
Millet japonais	3658 a[1]	Trudan IV	2637 be	Sughage	2710 befgh
Avoine	3009 b	Funks 77F	2544 beg	Trudan II	2348 bdeh
Haygrazer	2934 bc	Sudax	2496 beh	Funks 92F	2118 cdeh
OX-3071	2850 bc	8028	2487 beh	Trudan I	2079 cdeh
SS 10 x 10	2791 bc	SS — 15	2464 beh	BL — 51	2046 cdeh
Sughum	2761 bd	8029	2424 beh	BL — 50	1881 dgh
R.P. Mor-Su	2693 bc	Jacque Sue	2413 beh	Millet hon.	1868 cdefh
Greenlan	2683 bc	Sordan	2389 cdeh	Sugar Cane	1823 dh
FFR — 66	2673 bc	Sudan-grass	2377 bcdeh	Mil. Crown	1750 h

TABLE 2. EFFET DES ANNÉES ET DES COUPES SUR LES RENDEMENTS EN MATIÈRE SÈCHE DE SORGHOS HYBRIDES ET D'AUTRES PLANTES FOURRAGÈRES ANNUELLES. MOYENNES PONDÉRÉES EN kg/ha. LENNOXVILLE 1965-1967.

	1965	1966	1967	Coupes
Date	13 août	23 juillet	26 juillet	
Coupe 1	2853 a[1]	2558 c	2923 b	2778 a
Date	20 sept.	28 sept.	12 sept.	
Coupe 2	1073 c	2958 a	2503 b	2178 b
Effets des années sur les rendements	1963 b	2758 a	2713 a	2478

TABLE 4. PERFORMANCE DE SIX INDIVIDUS DE PLANTES FOURRAGÈRES ANNUELLES. RENDEMENTS MOYENS PONDÉRÉS DE MATIÈRE SÈCHE (kg/ha). MACDONALD COLLÈGE 1964-1967.

Variétés	1964	1965	1966	1967	Moyenne
Funks 92F	(12557)[1]	11994	12802	18199	13888 a
Algonquin	(11994)	11431	12239	17636	13325 a
R.P. Mor-Su	12649	12086	12894	18291	13980 a
Greenlan	11575	11012	11820	(17217)	12906 a
Funks 77F	9634	(9071)	9879	15276	10965 b
Sudax	9931	(9368)	10156	15573	11262 b
Moyenne	11390 b	10827 b	11635 b	17032 a	12721

[1] Les chiffres entre parenthèses sont des estimés.

TABLE 5. RENDEMENTS EN MATIÈRE SÈCHE DE PLANTES FOURRAGÈRES ANNUELLES. (kg/ha) SEMÉES À QUATRE DIFFÉRENTES DATES. MOYENNES PONDÉRÉES DE TROIS ANS. LENNOXVILLE 1965-1967.

	24 mai	Début juin	Mi-juin	Début juillet	Moyenne
Maïs 200	13917	16863	12425	9739	13235 a
Funks 77F	10898	13844	9406	6721	10216 b
Millet japonais	10773	13719	9281	6595	10092 b
Funks 92F	10561	13507	9069	6383	9880 b
R.P. Mor-Su	9898	12844	8406	5720	9217 b
Greenlan	9855	12801	8363	5677	9173 b
Millet hongrois	9302	12248	7810	5214	8621 b
Sudax	9301	12247	7809	5123	8620 b
Sugar Cane	7643	10589	6151	3465	6962 c
Sudangrass	7355	10301	5863	3177	6674 c
Avoine	7237	10183	5745	3059	6555 c
Millet Crown	6528	9474	5036	2350	5847 c
Effets dûs aux dates de semis	9438 b	12385 a	7947 c	5621 d	8758

Sudax, Semis le 1er juin 65—Photo Septembre 1965.

Wart on potatoes, showing range of symptoms from small tumor to infection of entire tuber.

BREEDING POTATOES

for resistance to wart and golden nematode

O. A. OLSEN

Potato wart disease, or "canker", caused by *Synchytrium endobioticum* has been known in Newfoundland since 1909. It is now widespread throughout the island and is a serious and destructive disease. Potato wart is also found in many areas of Europe and elsewhere but it has generally been well controlled by wart-immune potato varieties. However, the biotype or physiologic race of *S. endobioticum* present in Newfoundland produces wart on a large number of potato varieties that are immune to this disease in other countries. In a search for wart resistance made before 1957, Mr. G. C. Morgan[1] tested 95 named varieties and 117 numbered selections and found that only three varieties and one selection—Sebago, Ultimus, Urgenta and F5318—were resistant.

WART RESISTANT VARIETIES SOUGHT

In 1958, we started a potato breeding program at the CDA St. John's West Research Station with the objective of producing potato varieties of acceptable quality and yield with high resistance to wart. In the search for more sources of wart resistance, we have screened an additional 186 named varieties from the United States and Europe, plus several hundred selections developed by the National Potato Breeding Program at the CDA Research Station, Fredericton, N.B. Unfortunately, relatively few varieties or selections, which have high resistance to potato wart disease, were found. Worthy of mention are Fontana, Fortuna, Furore, Kennebec, Erdkraft, Fecula, Hilla, Appollo, Ora and Zeisig. Based on their response to wart infection, these varieties may be rather arbitrarily divided into three groups: immune, highly resistant, and resistant.

The last six listed are reported to be immune to the majority of the 10 European biotypes of *S. endobioticum*, and to date, wart has not been observed on them in Newfoundland. The varieties Ultimus and Urgenta are considered to be highly resistant because small wart tumors have been found only on the occasional tuber. Sebago, Kennebec, Fontana and Furore are resistant in the sense that though small wart tumors sometimes develop at the bases of

Wart development at base of stems of the potato plant. Entire crop—one small tuber.

The author, who has been Plant Pathologist at the CDA Research Station, St. John's West, Nfld., became an Associate Professor at Memorial University, St. John's, in August 1968.

[1] Officer-in-charge, Commodity Inspection, CDA Production and Marketing Branch, St. John's Nfld.

stems and on a few tubers, an essentially wart-free crop can be produced in heavily infested land.

Another source of resistance is in *Solanum tuberosum* subsp. *andigena*, a wild Andean species of potato. When crossed with the common potato, *S. tuberosum*, variety 'Ulster Knight' (received from Dr. H. W. Howard, Plant Breeding Institute, Cambridge), it produced a number of highly resistant or possibly immune clones which have good horticultural characters. Among wild potato species, *S. vernei* and *S. verrucosum* have been tested and all clones have remained free from infection, while lines of the potato *S. stoloniferum* and *S. brachycarpum* have segregated into resistant and susceptible clones.

Utilizing many of the varieties and species mentioned above, we have made many crosses of wart resistant × susceptible and resistant × resistant varieties and grown many thousands of seedlings. Because the Research Station and surrounding farm district is free from wart and golden nematode, testing for resistance to these pests is done in infested fields at Cupids and Avondale, Newfoundland. To maintain wart-free material, all seedlings and varieties are grown at St. Jonh's, but only the seedlings found to be wart-free in the test plots are retained for further testing. It is necessary to retest wart-free seedlings several times because a parent resistance is often found to be merely escape from infection.

Of 31 progenies tested for wart resistance from 1963 to 1966 inclusive, six progenies derived from selfing a highly resistant parent such as Ultimus or from crossing two such varieties, have given the highest percentage (66%) of wart-free clones. Four combinations of highly resistant × resistant varieties, such as Urgenta × Sebago, yielded 60 percent wart-free clones; nine crosses of highly resistant × susceptible (i.e., Ultimus × Arran Victory) produced 42 percent resistant clones; three progenies from resistant × resistant parents averaged 30 percent wart-free clones, and nine combinations of resistant × susceptible parents gave only 11 percent of clones in which wart was not observed. As mentioned above, selected hybrids with *andigena* subsp. have very high wart resistance or possible immunity. One of these, crossed with the wart susceptible Hol.-37, produced a progeny with the highest percentage of wart-free clones yet tested. A number of selections from it compare very well with those from pure *S. tuberosum* progenies.

GOLDEN NEMATODE EXTENDS PROGRAM

When golden nematode, *Heterodera rostochiensis*, was discovered in Newfoundland in 1962, we extended our program to include breeding for resistance to this pest. European scientists have found that at least four physiologic races or pathotypes of golden nematode exist, which can be distinguished by the potato varieties these races are able to attack. These investigators have also found that two types of resistance exist: (1) immunity from a specific pathotype, illustrated by certain clones of *andigena*, subsp., and (2) a generalized resistance against all pathotypes of golden nematode which is found in *S. vernei*.

To further our research at West St. John's, we obtained varieties and seedlings bred for immunity from pathotype (it makes up the major part, and in some cases, all of a population of golden nematode) from the U.S.A., United Kingdom and Europe and tested them for resistance and adaptability to Newfoundland conditions. Several of these are quite promising for breeding, and we have recommended Peconic, developed at Cornell University, for planting in fields where golden nematode is a problem.

Segregation of wart-susceptible and wart-free clones grown in infested field. Susceptible seedling on left, two wart-free seedlings in centre.

When its chromosome number has been doubled by colchicine treatment, *S. vernei* will cross readily with *S. tuberosum*. From such crosses, we have obtained progenies with resistance to both potato wart and golden nematode. Relatively few nematode cysts (less than 25 per plant) develop in the roots of the most resistant hybrids, indicating a generalized field type of resistance rather than immunity. Yields are relatively good but tubers are rough. We have intercrossed these hybrids to get segregation of clones with increased resistance to golden nematode and wart and also backcrossed to *S. tuberosum* to improve the tuber characters. These progenies have not yet been tested.

After several years of selection for good horticultural qualities and disease resistance, selections are compared in replicated yield trials at St. John's West and at four other locations across the province. At the present time, several promising seedlings are in their final stages of evaluation as possible wart resistant varieties for Newfoundland. Our first resistant variety of potatoes will be released from the Station in the spring of 1969. ■

C. E. LILLY

IN CLICK BEETLES OF THE SUGAR-BEET WIREWORM SEX ATTRACTANT IDENTIFIED

The sugar-beet wireworm, *Limonius californicus* (Mannerheim), is an insect pest that attacks sugar beets, potatoes, corn, onions, cereal grains, and other crops grown in irrigated fields of Western Canada and the Pacific Northwest. The larvae develop in the soil where they feed on underground plant parts, causing considerable damage. The adults are commonly called click beetles because when placed on their backs they spring into the air with an audible click. The beetles emerge in the spring and immediately after mating the females go below ground to deposit their eggs.

At the present we have efficient soil insecticides that adequately control wireworms and protect crops. Unfortunately, the most effective wireworm-killers, aldrin and heptachlor, leave toxic residues in crops such as sugar beets, potatoes, and carrots, and are also believed to contaminate meat and milk. For this reason the use of these insecticides has been banned or drastically reduced.

In an effort to find other efficient yet safer methods to control wireworms we have been carrying out long-range experiments at the Lethbridge Research Station with the adult beetles of a number of species of wireworms, in an endeavor to discover and use chemical compounds that female beetles produce to attract the males. To date, attractants have been extracted from five of the species tested but the most productive results have been obtained with adults of the sugar-beet wireworm.

While studying the behavior of adults of the sugar-beet wireworm in the field we observed that the males spent much of their time after emergence resting on small clods of earth with their heads pointed upward into the breeze and with their antennae waving as though testing for odors (Fig. 1). When they appeared to intercept a chemical stimulant they moved into the breeze, crawling or flying, depending on the velocity of the wind. As they neared the female, the males became increasingly agitated; eventually one of them located her and mated with her almost immediately. Our observations suggested that the females, soon after emerging, release a chemical compound to attract the males.

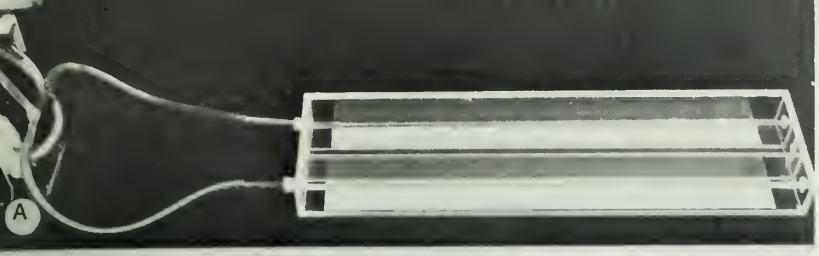
We proved later that a chemical attractant was

The author is an Entomologist with the Research Station, Canada Department of Agriculture, Lethbridge, Alberta.

Fig. 1—Adult male of the sugar-beet wireworm is testing air currents for presence of female attractant.

*Fig. 2—*A *an olfactometer used to test the reactions of male click beetles to extracts of unmated females.* B *detection of sex attractant on strip of filter paper by males of the sugar-beet wireworm.* C *closeup of a group of the males exhibiting sexual behavior on the active zone.*

Fig. 3—Specimens from four economic species of click beetles found in Western Canada. Parthenogenetic strains are found in the two smaller species.



2

present in the abdomens of unmated female beetles and that we could extract it readily in 70 per cent ethyl alcohol. In the field all males that responded to the extract came against the breeze from as far away as 90 feet, and their actions were very similar to those exhibited by males approaching receptive females. On one occasion more than 300 male beetles were attracted to a single small brush moistened with the extract and left in the field during the day.

Diethyl ether also proved to be an efficient solvent for extracting the attractant. It was used almost exclusively in laboratory tests because, due to its high volatility, the attractant it contained could be easily concentrated on small areas of experimental paper strips. We found that ethyl alcohol was a more practical solvent for use in the field.

Unmated female beetles were very difficult to find in the field. However, in 1967 we were able to prepare an ether extractive (50 mg) by the continuous (Soxhlet) extraction (for three hours), of only 18 abdomens of unmated females. Then, in cooperation with Dr. Martin Jacobson and Charles Harding, of the Entomology Research Division, USDA, Beltsville, Maryland, we began the rather difficult task of isolating and identifying the natural sex attractant. The crude extract was fractionated by column chromatography and activity in the fractions was determined by bioassay using an olfactometric method that we developed at Lethbridge to determine sexual attraction for species of click beetles in the laboratory (Fig. 2). Activity was found in one chromatographic fraction, which was then further fractionated with basic media; the activity was retained in a liquid acid fraction. This active fraction was then characterized by gas-liquid chromatography, infrared, and mass spectrometry. It proved to be a readily available chemical—valeric acid. Male beetles in the laboratory responded identically to diluted synthetic valeric acid and to the natural attractant although they were confused and repelled by the concentrated acid.

This is the first recorded isolation and identification of a sex attractant from click beetles; such attractants have been identified in only seven other insect species to date. The large amount—more than 100 micrograms—of valeric acid obtained from each female suggests that she stores the attractant in her abdomen and releases it as needed. We found that for at least four hours after mating, a female beetle contained as much attractant as an unmated female. However, as post-mating time increased the amount recovered decreased fairly rapidly.

The value of identifying this attractant becomes evident when one compares the ease of obtaining valeric acid from drug supply houses with the difficulty of searching for widely scattered, unmated female beetles in the field. Indeed, it would be extremely difficult to obtain unmated females in sufficient numbers from the field to provide enough natural sex attractant for trapping purposes. The long, complex life-history of the wireworms would make the task of obtaining adults by laboratory rearing equally difficult.

Now that we have identified the attractant of the sugar-beet wireworm a number of control methods become possible. Traps lined with sticky substances or with insecticides and baited with valeric acid could be placed throughout infested fields to attract and destroy the males before they could mate with the females. Valeric acid plus a chemosterilant applied in the field could attract and sterilize the males, which could then be released to mate with females of the species and cause them to lay infertile eggs. There is also the possibility of distributing small amounts of valeric acid over the surface of infested fields to confuse the males so that they fail to find and mate with females of the species.

One possible weakness in using sex attractants to control click beetles could be the selection and increase of a parthenogenetic strain in which females produce viable eggs without mating, or of a strain in which the males are unresponsive to the attractant. At least two species of click beetles in western Canada are known to have parthenogenetic strains (Fig. 3) and, therefore, presumably have no need for sex attractants. ■

DETECTION OF TAINT IN PORK —The characteristic odors of cooking meat result because of volatilization of components of the tissues. Because of this fact, the frying of a sample of meat is a useful method for detecting undesirable taints.

The frying procedure is time-consuming and messy, and the equipment used for frying must be washed thoroughly between each sample to be tested.

A much simpler technique of taint detection in the swine carcass has been developed at the CDA Research Station, Lacombe, Alta. This consists of a pistol grip electric soldering iron with continuous build-up heat. The unit weighs only a few ounces, operates on 115 volts, heats up rapidly and stays hot when plugged in. Since there is no "on" or "off" trigger switch it is always ready to use and requires no cleaning or washing between tests since the continuous heat burns all residue away.

In operation the unit is simply plugged in, allowed to heat and applied momentarily to the sample to be tested. The melted fat instantly releases any aromas which may be present. The technique works on fresh or frozen samples as well as on cured products such as hams, bacons or processed lards and other pork products.

The unit costs under $5.00 and the technique may be employed anywhere convenient to an electric outlet. It would be appropriate for use on the killing floor of a packing plant or in the cooler for carcasses hanging on the rail.—L. JARMOLUK, LACOMBE, ALTA.

CUCUMBER MOSAIC VIRUS — Unusually heavy outbreaks of mosaic virus disease in regional field crops of cucumbers at Ottawa in the past two seasons have raised suspicions that they were caused by a virulent new strain of the virus.

This is being investigated by researchers at the CDA Research Station, Ottawa, Ont. They have begun comparing the mosaic virus strains found in the Ottawa area with those found elsewhere in Canada and the United States. They suspect that a new strain may be involved, because Armour, a cucumber variety developed at Ottawa, suffered damage both seasons although, before 1966, it had shown freedom from attack.

In both 1966 and 1967, the first symptoms of the disease appeared around mid-July. By the end of the month varieties highly susceptible to the disease —such as Marketer, Straight 8, Delcrow, Highmoor and Downeast Slicer—either had been killed or left badly stunted, yellowed and unproductive of marketable fruit. These are mostly older varieties that have been widely grown in eastern Ontario and the notable symptom with them was sudden wilting of the entire plant, and, in many instances, death within five to 10 days.

Use of resistant or highly tolerant varieties is the best way to overcome the threat of mosaic virus disease. Recommended are the slicing varieties Burpee Hybrid, Challenger and Triumph, and the pickling varieties Wisconsin SMR 18, SMR 58, Spartan Dawn and NK 851.—V. W. NUTTALL AND A. T. BOLTON, OTTAWA, ONT.

HOW COOLING RATE EFFECTS EGG WHITE QUALITY — Observations by inspectors of the Canada Department of Agriculture indicate that the incidence of watery whites in eggs at the retail level in Canada has increased during the last 6 to 7 years. This change appears to correspond with the expanding usage of egg washers in egg grading stations. Since washing increases temperature, and egg white quality as indicated by Haugh unit measurement is known to depend on holding temperature, it was decided to make a survey of temperatures during handling and holding in local egg grading stations. This was followed by a series of laboratory tests in which egg temperatures were measured under conditions similar to those in egg grading stations. Finally, the change in Haugh unit value was determined in laboratory tests using the temperatures and holding times found to occur in egg grading stations.

The results of the cooling and Haugh unit value tests, taken together, indicate that present methods of packing eggs in corrugated cardboard boxes and handling them in pallet loads causes marked loss of quality of eggs. The results also indicate that substitution of wire baskets for corrugated cardboard boxes would substantially reduce the problem of watery whites by allowing quicker cooling. Eggs packed in wire baskets would also warm up more quickly if exposed to warm conditions such as might occur during transport in the summer, if precautions were not taken to prevent this. Cooling the eggs to 50°F prior to packing in corrugated cardboard boxes would also reduce the watery white problem and would allow flexibility in handling temperatures but would increase costs.—D. A. FLETCHER, OTTAWA, ONT.

Dr. G. C. Russell of the Canada Department of Agriculture offers the ceremonial spade to Governor-General Michener for a tree planting in Prince Edward Island. (see below).

M. G. C. Russell, du ministère de l'Agriculture du Canada, présente à Son Excellence le Gouverneur Général, monsieur Roland Michener, la pelle symbolique à l'occasion d'une brève cérémonie où un petit érable a été planté à l'occasion de la visite de l'éminent personnage à Charlottetown, dans l'Ile du Prince-Édouard. (voir à droite).

TREE PLANTING CEREMONY — Governor-General and Mrs Michener planted a maple tree on the lawn of the CDA Research Station at Charlottetown, P.E.I., and met senior members of the staff during their recent tour of the Maritime Provinces.

Dr. J. A. Clark, who is 90, and was the first superintendent of the Experimental Farm (1909-1947), and R. C. Parent, the second superintendent (1947-1966), were with Dr. G. C. Russell, the present Director of the Research Station, to greet the distinguished visitors.

The ceremony marked the tenth time that a Governor-General has planted a tree at the Station since the Duke of Connaught began the tradition in 1912. The custom has also been observed by other members of the Royal Family including Queen Elizabeth, who planted a tree in 1951 when she was Princess Elizabeth.

The Governor-General wielded the spade that has served all these occasions and which is inscribed with the names of previous users.

CÉRÉMONIE DE PLANTATION D'UN ARBRE—Son Excellence, le gouverneur général et Madame Michener ont planté un érable sur la pelouse de la Station de recherches du ministère de l'Agriculture du Canada, Charlottetown, I. du P.-É., lors de leur passage dans les Provinces Maritimes.

M. J. A. Clark, âgé de 90 ans, premier régisseur de la ferme expérimentale soit de 1909-1947, et M. R. C. Parent, deuxième régisseur (1947-1966), accompagnaient M. G. C. Russel, le directeur actuel, pour accueillir les distingués visiteurs.

C'était la dixième fois qu'un gouverneur général plantait un arbre à la Station depuis que le duc de Connaught a inauguré la tradition en 1912. La coutume a également été observée par d'autres membres de la famille royale, y compris la Reine Elisabeth, qui a planté un arbre en 1951 lorsqu'elle était la Princesse Élisabeth.

Le gouverneur général a utilisé la même pelle qui a servi à toutes ces occasions et sur laquelle sont inscrits les noms de ceux qui l'ont maniée dans le passé.

GOODNESS FLAKES — Instant fruit sauce flakes in a wide variety of popular flavors and colors are a versatile new food ingredient. Housewives can reconstitute them into a sauce in a few seconds by mixing them with cold water.

Normally 2½ to 3 containers of water are mixed with one container of flakes. Thick purees for use as sundae toppings can be made by mixing equal volumes of water and flakes.

Dry flakes may be used as a stable, low-cost fruit ingredient for packaged cake and muffin mixes. They may also be compressed into discs, tablets, granules or bars. These can be used to add a note of natural fruit color and flavor to packaged breakfast cereals or candy.

The new product was developed at the CDA Research Station, Summerland, B.C. The flakes were made by blending fruits such as strawberries, raspberries, loganberries, cranberries, blueberries, black currants or bananas with varying amounts of applesauce, then drying the mixture on a double-drum drier.

The drier, which looks like a clothes wringer, compresses the mixture which clings to the rollers. As it rolls around on the drier drum, it is cut by doctor blades and taken off in sheets. The dry sheets are crumbled into flakes when they cool.—J. KITSON, CDA RESEARCH STATION, SUMMERLAND, B.C.

FLOCONS DE SAVEUR — Un nouvel aliment aux usages variés, soit des flocons instantanés de purées de fruits représentant un vaste assortiment de saveurs et de couleurs populaires vient d'être créé. Les ménagères peuvent reconstituer les flocons en purée en quelques secondes en les combinant à de l'eau froide.

Normalement, on mélange de 2½ à 3 volumes d'eau avec un volume de flocons. Des purées épaisses pour couronner les coupes glacées peuvent se faire en mélangeant l'eau et les flocons en quantités égales.

On peut utiliser ces flocons déshydratés comme ingrédient stable et peu coûteux pour remplacer les fruits dans les mélanges à gâteaux et à brioches. On peut aussi les comprimer en disques, tablettes, ou en granulés. Ils peuvent aussi servir à ajouter la couleur et la saveur de fruits nature aux céréales du déjeuner ou aux friandises.

Le nouveau produit a été créé à la Station de recherches, Summerland, C.-B. Les flocons se font en mélangeant des fruits comme les fraises, les framboises, les mûres Logan, les canneberges, les bleuets, les cassis ou les bananes avec diverses quantités de purée de pommes puis en séchant le tout dans un dessicateur à double cylindre.

Ce dessicateur ressemble à une essoreuse, et comprime le mélange qui adhère aux rouleaux. En tournant autour des cylindres d'assèchement, le mélange est coupé et retiré en feuilles. Ces feuilles desséchées sont émiettées en flocons après le refroidissement—J. KITSON, STATION DE RECHERCHES DU MINISTÈRE DE L'AGRICULTURE DU CANADA, SUMMERLAND, C.B.

FOOD SHOW AT LONDON — British consumers recently drank Canadian apple juice, ate warm apples straight from an ultra-modern micro-wave oven and sampled Canadian apple sauce.

The occasion was the Canadian exhibit at England's biggest food show, staged in London once every three years. All the newest foods were on display at this year's show, called Food Pack International 68.

Exhibitors came from all parts of the world, each hoping for a portion of the British consumer's weekly food budget.

But the Canadian exhibit also showed how Canadian research is discovering different crops, helping our farmers to grow new and better foods, and industry to develop better processing methods.

The exhibit, a 1,200-square-foot education center, was produced by the CDA Research Branch. It featured the story of rapeseed, the latest varieties of which, bred by CDA researchers, are yielding oils which can compete with traditional food oils.

SOIL LIMING—Growers can improve any of their soils suffering from "acid indigestion" by feeding them two tablets of lime. If they do, profits could increase five-fold or more.

Liming the acid soils of eastern Canada will increase yields and profits dramatically. $1 worth of lime could result in $5 to $10 worth of increased crops over the long haul. Liming acid soils, therefore, not only pays, but pays handsomely.

In tests at the CDA Research Station, Nappan, N.S., barley grown on soil with a 6.9 pH reading (which is almost neutral) yielded 60 bu/acre. An adjoining field with a 4.7 pH reading (which is very acidic) without line yielded 5 bu/acre—or less.—L. P. JACKSON, NAPPAN, N.S.

CONTROLLING BLACK ROOT ROT OF TOBACCO—Experiments at the CDA Research Station, Delhi, Ont., show that black root rot of tobacco cannot be effectively and consistently controlled by chemicals.

To find out why, several chemicals were used, as well as steaming in an artificially-infested greenhouse experiments. Steaming was the only treatment that resulted in white and healthy roots; chemical treatment did not stop black root rot infection.

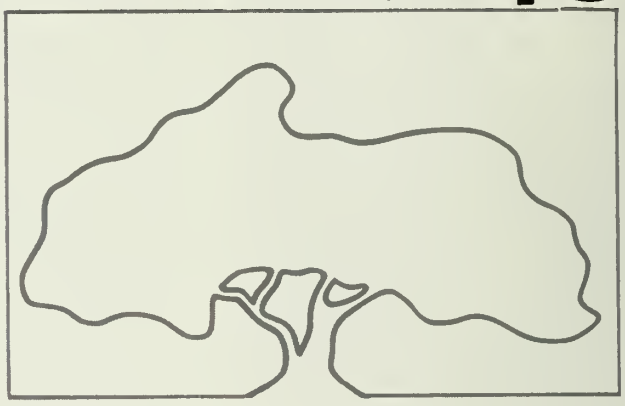
The chemicals did, however, decrease the severity of infection.

The experiment was conducted with Vorlex and Vorlex 201 applied at 40, 50 and 60 gals/acre; Allyl alcohol applied at one, 1.5 and two gals per 1,000 sq ft; Formalin in concentrations of four, 10 and 20% applied at 66 millilitres per sq ft and dazomet (Mylone) applied at one, 1.5 and two lbs per 100 sq ft.

The chemical and steam treatments were carried out in the fall. In the spring, the treated and control areas were sown with White Mammoth tobacco seeds, a variety susceptible to black root rot.

The experiments showed that infection decreased as chemical strength was increased. The best chemical control came from Vorlex and Vorlex 201 applied at a rate of 60 gals/acre and dazomet (Mylone) applied at two lbs per 100 sq ft.—S. K. GAYED, DELHI, ONT.

VIRUS DISEASE PROBLEMS IN ONTARI



W. R. ALLEN, H. F. DIAS, and T. R. DAVIDSON

Viruses—are they in all of our fruit crops? Yes, we believe they are. Are they causing more problems in Ontario than in other provinces or countries? No, we believe not. Some viruses apparently are not present in Ontario and some of those that are appear to be causing only minor damage. Are certain fruit crops carrying a greater number of viruses than others? Our present knowledge indicates that stone fruit crops are carrying the greater number of viruses. Are we learning to control the spread of viruses and how to select or produce virus-free stock? For most viruses the answer to both questions is yes.

In about 1940, research on virus diseases of stone fruits was started at the CDA Research Station in St. Catharines. That work has continued and has expanded to cover virus diseases of pome fruits and grapevines. In 1967, the staff moved into a new research building at Vineland where improved facilities have provided for new kinds of research in the fruit virus program.

A survey of the world literature indicates that there are over 100 virus diseases of stone fruits, over 30 of pome fruits, and about 11 of grapevines. However, a number of these diseases are now known to be caused by the same virus and undoubtedly identities in the casual viruses will be shown for other diseases. On the other hand, diseases once thought to be caused by the same virus are now known to be caused by distinct viruses. The entire picture of virus diseases is further confused by the knowledge that two or more viruses may be responsible for complex symptoms, once recognized as a single disease. Therefore, it will be sometime before a reliable estimate of the number of viruses infecting these fruit crops can be made.

Our information indicates that, of the many virus diseases of stone fruits, less than a half-dozen are considered a problem in Ontario. New viruses are being detected every year but thus far none seem to be of economic importance, either because of the low incidence or because the viruses are latent (hidden) or are causing only mild diseases.

Necrotic ringspot and sour cherry yellows (prune dwarf virus) are still our most damaging viruses; in some years they reduce yields by 50 to 80 percent. Although these two viruses infect all stone fruits, sour cherry (*Prunus cerasus*) remains the most susceptible species. Control of these two diseases has not been satisfactory. A major contribution of this Station was to show that both viruses are carried in the pollen. Therefore, even though a new planting may be virus-free, infection will soon result through pollenation from adjacent infected plantings. If eradication of these viruses proves to be impossible without destruction of entire orchards, methods must be developed to restore the productivity of diseased trees. It has been recently shown that the use of gibberellic acid sprays at the proper time and concentration will do much to correct the effects of the yellow virus. This material, along with corrective pruning and approved fertilizer practice, should help to restore productivity. Additional treatments and practices are being investigated as they hold promise for improving production in infected orchards.

The authors are plant pathologists at the CDA Research Station, Vineland, Ont.

A—Healthy Montmorency; B—Montmorency infected with necrotic ringspot virus; and C—Montmorency infected with the prune dwarf virus.

At present it appears that the other recognized virus diseases of stone fruits in Ontario can be controlled by the use of virus-free stock, by the removal of infected trees, and by the use of pesticides to eliminate the virus carriers. Although the means of spread (other than by the use of infected stock) of all of these viruses is not yet known, the rate of spread is sufficiently slow to enable control by roguing.

A number of stone fruit viruses have been isolated, characterized, and identified at this Station. This work has given us information necessary for the detection of natural alternate hosts of the viruses, for the rapid screening of experimental stock for infected individuals, for determining means of dissemination, and for developing control practices for some diseases.

Virus diseases of pome fruits, pear and apple, have been extensively studied for about 10 years. Only since the early 1960's, however, has progress been made toward the isolation, characterization, and identification of these viruses. In a few cases, viruses have been transmitted from pome fruit trees to herbaceous plants and back again to healthy members of the original varieties. In this way the exact cause of a specific disease has been learned. This type of information, now available for many stone fruit viruses, must eventually be obtained for the pome fruit viruses if we are to know the number of distinct diseases with which we are dealing.

Extensive field surveys throughout Ontario have shown very few obviously diseased apple or pear trees, although it is certain that many if not most of the trees of certain varieties are carrying one or more viruses. Many varieties are so tolerant of a number of

viruses that disease symptoms are not obvious. There is also reason to question whether Ontario's growing conditions are generally favorable for the strong expression of symptoms of a number of these diseases.

It is not implied that latent infections cause no injury or that they are not potential problems. On the contrary, if infected but tolerant understocks are budded to intolerant varieties or vice versa, a seriously diseased tree will be the result. In some instances where more tolerant varieties are used, poor bud take, poor growth, or both may result.

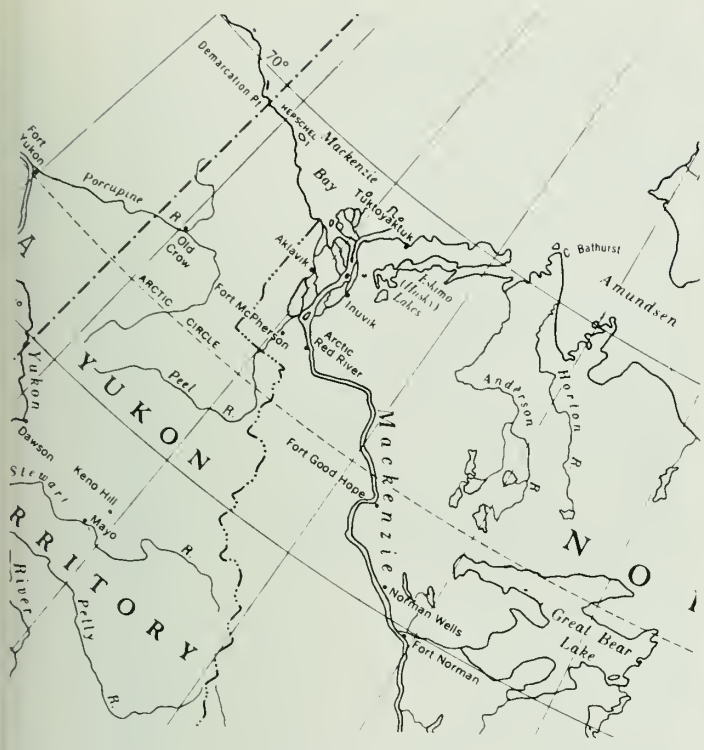
Work at Vineland is now progressing on the characterization and identification of pear and apple viruses transmitted to herbaceous plants from trees, seedlings, and from pollen imported for artificial pollenation. Of particular interest is the question of seed-transmission since seedling rootstocks are largely used in the production of Ontario trees. Also, plans have been made to use the new heat-therapy facilities to aid in the production of virus-free stock.

Viruses of grapevines, like viruses of pome fruits, have been disseminated throughout the world by unrestricted exchange of varietal and rootstock selections. Certain of these viruses, especially those with efficient insect or nematode carriers, have caused tremendous damage in some countries. For example, the insect borne virus of Pierce's disease has twice reached epidemic proportions in grapes in California. There in 1941, the disease destroyed some 18,000 acres as the result of the rapid spread of the virus and the quick decline of the infected vines.

The Ontario grape growing industry appears to to be fortunate with respect to detectable virus problems. The native varieties are still free of the important virus diseases largely because they are being grown on their own roots and thus have avoided infection through grafting onto infected, imported rootstocks. The fan leaf virus has been carried to Ontario from Europe in certain French stock. This virus apparently has not spread from the imported stock probably because the nematode carrier is not native in our soil. It should be kept in mind, however, that the indiscriminate use of imported rootstocks could quickly change the health of Ontario's grapevine population.

In cooperation with the Ontario Horticultural Research Institute at Vineland, measures are being taken to obtain, maintain, and to distribute virus-tested budwood, seed, and understocks of most of our fruit species. The inventory of requested stock is not yet complete nor is there enough available stock to meet the demands. In order to speed up this program, virus-tested stock is being imported from reliable workers in other parts of Canada, the United States, England, and elsewhere. ■

Damage caused by the prune dwarf virus (syn. sour cherry yellows virus) in prune. Similar symptoms may develop in sour and sweet cherries when infected by the more severe strains of this virus.



Gardening at INUVIK

R. E. HARRIS

Gardening in the Canadian Arctic and Sub-Arctic is not new. As early as 1789, Alexander Mackenzie, on his way to explore the river that now bears his name, wrote of the excellent garden at the mouth of the Athabasca River, grown by Peter Pond, a fur trader. The late Dr. Albright, then Superintendent of the Experimental Sub-Station at Beaverlodge, visited some 15 gardens along the Mackenzie River in 1930, three of them north of the Arctic Circle. According to his reports all were excellent. The gardens were on light textured soils that thawed-out and warmed up quickly in the spring.

Since over 75% of the land area of Canada has a polar or sub-polar climate, there are many areas where a short season and cool soil greatly restrict the number of vegetables that can be grown without special cultural treatment. In the far north, where the soil is permanently frozen in its native state, this situation exists in the extreme.

The Inuvik town site (68°N) near the mouth of the Mackenzie River, 127 miles north of the Arctic Circle, is located on permafrost. Yet, with good cultural practices, many types of vegetables grow during the long days of Inuvik's brief summer. When planning the town site the Department of Northern and Indian Affairs set aside areas for gardens. This was done in an attempt to encourage the inhabitants of the north to improve their standard of living, and reduce their cost of living by growing some of their own food.

To solve some of the problems associated with gardening on permafrost the CDA Research Branch established a one-acre test site in the garden area of Inuvik in 1956. The research was under the supervision of the Experimental Farm at Fort Simpson until 1964. Since then research has been directed by the Beaverlodge Research Station.

Vegetables growing in ridges and terraces in C.D.A. garden. Note natural windbreak in background.

The site, in the Mackenzie delta, is not the best location for gardening. Some of the delta land along the river is undoubtedly better, but this land is not easily reached from the town. The unfavorable nature of the site guarantees that if you can produce vegetables here, then there are a great many locations throughout the north where vegetables could be

Dr. Harris is Head, Cereal, Oilseed, Fruit and Vegetable Section, CDA Research Station, Beaverlodge, Alta.

grown. Many of the techniques developed through research at this site will be generally useful in areas where cool soils limit plant growth.

The site at Inuvik is on the southwest slope of a small ridge. Natural cover was 20-ft. high aspen poplar interspersed with spruce and birch, and dwarf shrubs. These were growing on 8 to 14 inches of moss and partially decomposed organic matter overlying 4 to 6 inches of gravelly loam, overlying clay. Under natural vegetation only the top 15 inches of cover normally thawed during the summer. After the land was cleared and broken, thawing increased each year reaching a maximum depth of 7 ft. after 8 years.

The one-acre site was cleared of plant growth and 6 to 8 inches of the undecomposed organic matter in 1956. The remaining soil had a pH of 6.4, conductivity of 0.8 mmhos, no nitrates or sulphates, 3.2 lbs of phosphorus per acre, a trace of potassium and 130 ppm. of calcium. The temperature of the cleared soil at 4 inches in late May is about 35°F, increasing to 45° by mid-June, 57° by mid-July and 60° by mid-August. The growing season at the Inuvik site is approximately 90 days with 900 degree days over 42°F. The frost-free period is approximately 52 days, killing-frost-free period 80 days, and mean July temperature 55°F.

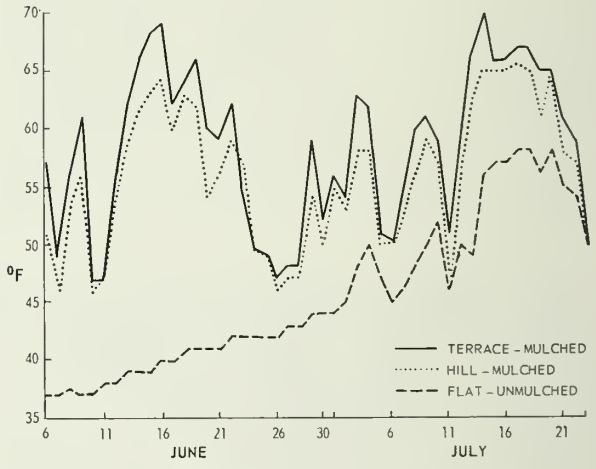
During the first few years vegetable production on the site was disappointing. However, each year further knowledge obtained was used to improve the management for the following year. Field tests to determine the nutrient requirements of the soil were inconclusive, but greenhouse tests showed nitrogen, phosphorus, potash and sulfur to be lacking in the virgin soil. Using Comet radish as the indicator crop, it was found that the addition of all four elements to the 0 to 6 inch layer of soil increased yield by 150%, and to the 6 to 12 inch layer by over 700%. Additions of calcium, magnesium and the micronutrients did not increase yield. After 9 years under cultivation no response was obtained from sulfur in greenhouse tests but good response was obtained from additions of nitrogen phosphorus and potassium. As a consequence, 300 to 400 lbs per acre of 13-13-13 fertilizer was applied during 1966 and 1967 and this, together with improved knowledge of culture, produced the yields shown in Table 1.

Because of the short season, early seeding is essential for most vegetables. To allow early seeding the land is prepared the previous fall by removing the remains of the summer's crop, applying fertilizer and plowing or digging, leaving the surface as rough as possible. Also, if ridging and terracing is being used, it is completed before freeze-up.

We obtained better production of cabbage, cauliflower, kale, broccoli and head lettuce when the seed was pre-sprouted in the greenhouse in late April and pricked out into peat pots or plant bands. The plants were hardened off and planted in the field between June 6 and 15. Radish, leaf lettuce, beet, swiss chard and summer turnip were pre-sprouted and seeded directly into the field as soon as possible in June. This was often done standing on boards, to prevent sinking into the mud. With radish, leaf lettuce and turnip, we had a continual supply by planting every 10 days, up to the end of June, or early July.

Other vegetables did not mature properly unless the soil temperature was increased. Three or four-foot wide clear polyethylene mulches were most effective in doing this. They increased the maximum soil temperatures by as much as 12°F and mean soil temperatures by 5°F. Planting on hills or terraces and mulching with clear polyethylene increased maximum soil temperature by up to 16°F. The increases were greatest during the early part of the growing season.

Clear polyethylene mulches placed flat on the ground increased yields of beet, swiss chard, lettuce



Soil temperatures at 4 inches taken at 8 a.m. June 6 to July 24, 1967. Soil warm-up was below average in June.

and pea. Carrot, rutabaga and potatoes only produced satisfactory crops when grown in 12-inch high ridges or 14-inch high terraces covered with a clear polyethylene mulch.

In addition to vegetables, many flowers and some perennials can be grown successfully. Carpet of Snow and Rosie O'Day Alyssum, Double Mission Bells *Eschscholtzia* and Copenhagen Market *Gypsophila* are the best annuals for direct seeding; Pacific Beauty *Calendula*, Double Gaiety *Dianthus*, *Dimorphotheca*, Petite and Choice Double *Tagetes*, *Mathiola bicornis* and single *Petunia* are the best for transplanting.

Delphinium, native *Lupinus*, *Arabis alpinus* vars. Nana Compacta and Snowcap, *Pentemon*, and *Achilea Ptarmica* var. The Pearl are the best perennials followed by *Gypsophila rosea*, Blue Gem *Nemesia*, *Anemone multifida* and *Linum grandiflorum*.

Strawberries, rhubarb, chives and perennial onions are the most reliable of the perennial food crops. They must be fertilized with a 13-13-13 fertilizer every year, cultivated early in the spring and again

as frequently as possible to loosen and help warm the soil. Bonanza, Northerner and Protem strawberries and MacDonald rhubarb were the most promising varieties tested.

We, of the Research Branch, are not the only ones concerned with the production of vegetables at Inuvik. At about the same time as our plots were established, Father Adam, an experienced northern gardener, started a garden on the edge of the school grounds. He is using different methods and his garden also grows well. He first cleared the site of trees and shrubs and thoroughly broke up the layer of undecomposed organic matter. On top of this he added 14 inches of topsoil. A low board fence was placed on the windward side and good air drainage provided by leaving the opposite side opening into a shallow gulley. He constructed cold frames, 6 ft. wide by 30 ft. long and 10 inches high, with removable sashes covered with polyethylene. The frames are set on the ground and allowed to fill with snow. In early spring the sashes are put on the frames over the snow. The snow melts, the water soaks into the soil and watering is unnecessary for the rest of the season. As soon as the snow is melted, radish, lettuce and carrot are seeded and the cabbage and cauliflower transplants are put in for later field plantings. When the weather warms up the sashes are gradually moved and stored out of the sun. Father Adam uses old paper or plastic cups to grow his transplants and grows them in a window, whereas the C.D.A. uses peat pots or plant bands for growing the transplants in glass, or plastic covered greenhouses.

Due to the cost of hauling topsoil and building cold frames and sashes it costs more to start a garden using Father Adam's method. However, the improvements are more or less permanent, subsequent costs are small, and the frames can be used to grow early crops. Our initial costs involve only clearing of the land and preparing the seed bed and this is all that is required for some crops. However, if mulches and terraces are required they add to the costs as the mulches have to be replaced every year.

Because of the wide differences in methods of growing the plants and in the location of the sites, the growth and yield responses between the two methods cannot be compared. Nor should they really be compared, for they both provide an ample quantity of fresh vegetables for the table.

Many problems associated with gardening on permafrost remain, but enough has been done to show that many common vegetables can be grown under northern conditions. We have no doubt that further improvement in the techniques will result in higher yields and the production of a wider range of crops. Most of these will come about through the efforts of permanent residents like Father Adam. We sincerely hope the research that we have undertaken on permafrost at Inuvik will form the basis for this continuing and expanding production. ■

Vegetables grown on permafrost.

Top row: Left to Right. Lucullus chard, Copenhagen Early Market cabbage, Black Simpson lettuce.

2nd row: Ruby Queen beets, Scotch Curled kale, French Breakfast radish.

3rd row: Scarlet Nantes Coreless carrots, Super Snowball cauliflower, Italian Sprouting broccoli.

Bottom row: Victory Neckless rutabaga, Warba potatoes, Purple Top Milan turnip.

TABLE 1. SOME YIELDS OF VEGETABLES OBTAINED OVER PERMAFROST AT INUVIK, N.W.T.

Vegetable	Variety	Spacing		Yield in cwt/acre	Remarks
		Row	Plant		
		ft.	inches		
Radish	Comet	2	2	27.95	Flat, unmulched
Lettuce	Black Seeded Simpson	2	8	70.18	" "
Turnip	Purple top Mulan	2	4	185.13	" "
Beets	Ruby Queen	2	3	126.11	Hill, mulched 9 days earlier
		2	3	74.81	Flat, mulched
		2	3	57.50	" unmulched
Cabbage	Copenhagen Market Early	3	18	27.31	" "
Broccoli	Italian Sprouting	3	18	1.47	" "
Cauliflower	Stokes Super Snowball	3	18	8.09	" "
Kale	Green Scotch Curled	3	18	4.43	" "
Swiss Chard	Lucullus	3	12	7.58	" "
Peas	Alaska	3	—	13.64	" "
Rutabaga	Victory Neckless	4	4	97.87	Terraced, mulched
Carrot	Scarlet Nantes Coreless	4	2	10.89	" "
Potatoes	Warba	4	12	130.68	14 in. terraced, mulched
		4	12	81.78	12 in. hill, mulched
		4	12	68.41	8 in. hill, "

Western Encephalitis virus in Alberta

J. A. SHEMANCHUK

Western Encephalitis—often called sleeping sickness—is a disease that affects horse and man. Outbreaks of this disease in horses are known to have occurred at irregular intervals in Alberta as far back as 1939. The number of reported cases in the past decade has been on the increase, with the most serious epidemic occurring in 1965 when 320 cases were clinically diagnosed. Because this disease also affects humans, it is of concern from the public health as well as the agricultural aspect.

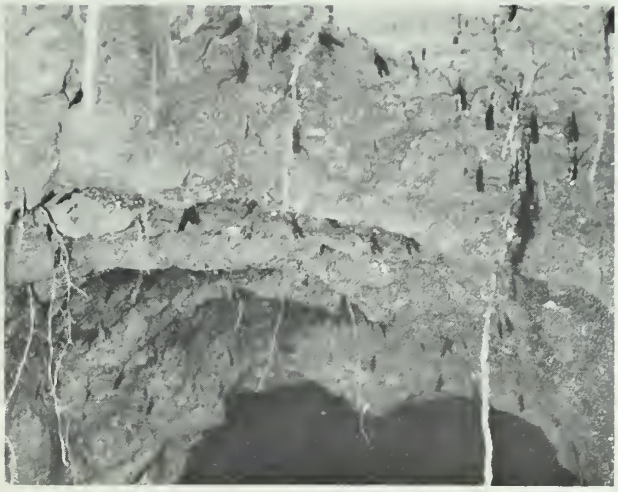
Western Encephalitis, according to our present knowledge, is caused by a virus transmitted by mosquitoes. During the summer months this insect becomes infected by feeding on wild birds and domestic fowl that have the virus in their blood. Birds can harbor high concentrations of this virus yet show no symptoms of the disease. Humans and horses infected by the bites of infected mosquitoes become ill and sometimes die.

To obtain more information on the ecology of Western Encephalitis virus in Alberta, the CDA Research Station at Lethbridge, Alta., working jointly with Dr. Odosca Morgante, Virologist, Provincial Laboratory of Public Health, University of Alberta, has isolated the virus from three species of mosquitoes from south central Alberta—*Culex tarsalis*, *Culiseta inornata* and *Aedes vexans*. We concluded that these species at least must be considered as vectors of the disease. During outbreak years the disease has a marked seasonal incidence with the majority of cases occurring during the summer months.

The incubation period of the virus in horses is from one to three weeks. During this time, the virus multiplies in the blood stream causing a fever that, in mild cases, is accompanied by a loss of appetite and a mild state of mental depression. These symptoms generally go unnoticed and the horses recover. In more severe cases, the symptoms are more noticeable; the animals may walk in circles, stumble blindly into objects and suffer mental depression ranging from dullness to complete coma and paralysis. Many of the animals with severe symptoms die, and those that recover physically remain witless exhibiting symptoms of permanent brain damage.

Earlier investigations have shown that wild and domestic fowl serve as reservoirs of infection during the summer months and that this source of infection is present every year in south central Alberta. It is believed that wild birds as well as mosquitoes may be active in the spread of the disease to new localities during the summer months. A question that still

The author is in the Veterinary-Medical Entomology Section at the CDA Research Station, Lethbridge, Alta.



Top—Chickens in cages exposed to bites of natural populations of mosquitoes: A study to determine the seasonal activity of Western Encephalitis virus among birds and domestic fowl.

Bottom—Mammalian burrows: Hibernating sites for adults of C. tarsalis *and* C. inornata, *both known vectors of the disease.*

Top—Adult mosquitoes hibernating on ceiling of a mammalian burrow; a suspected host for the winter survival of Western Encephalitis.

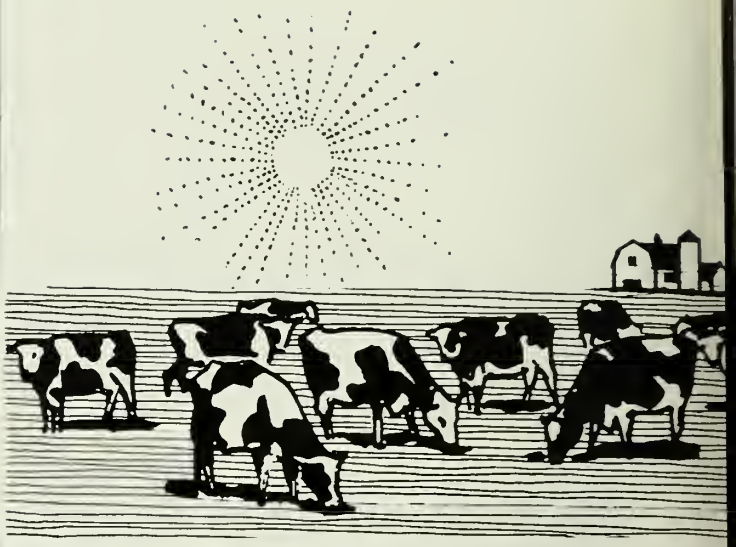
Bottom—Flocks of blackbirds on the move. These birds may be active in the spread of Western Encephalitis virus to new localities.

remains unanswered is where the Western Encephalitis virus is maintained during the severe winter conditions that exist in Alberta.

Recent studies have shown that two species of mosquitoes, *Culex tarsalis* and *Culiseta inornata*, both known vectors of Western Encephalitis virus, hibernate as adults in mammalian burrows. We know that these species enter their hibernation sites in late summer at about the same time that many vertebrates such as gophers enter the same sites to hibernate.

On the basis of these findings we at the Lethbridge Research Station are investigating two possibilities of winter survival of the virus. One is that infected, hibernating mosquitoes may harbor the virus during the winter months then emerge in the spring to infect birds or other vertebrates which will then serve as a source of infection to start the summer cycle. The other possibility is that mosquitoes could infect vertebrates (e.g. gophers) that inhabit the same hibernation sites. The virus may remain latent during the winter in the hibernating vertebrates. In the spring, the virus could multiply in the blood streams of these animals when they become active. It could thus reach high enough concentrations to be a source of infection for the early spring mosquitoes that may be active in starting the summer cycle.

An understanding of the mechanism of winter survival of Western Encephalitis should aid us in devising control measures against this disease. At present there is a vaccine which can be used to protect horses, but so far there is no vaccine which can be used on humans. The only protection for humans is to avoid being bitten by infected mosquitoes. ■



L. P. FOLKINS and W. R. CHILDERS

Champ is a new variety of timothy that was developed at the Ottawa Research Station and licensed in 1967. Our objective in a selection and breeding program was to produce a timothy that was high in tillering and aftermath production and equivalent to the standard varieties in total yield.

The capacity for high aftermath is important as most farmers graze the hay meadows after the first cut. Most of the varieties in present use do not have this aftermath production.

In our investigations we found that Champ is generally equal to the recommended variety Climax in first-cut yield and higher in aftermath. The plants are somewhat shorter than Climax but higher tillering (Fig.1). The seed heads also are shorter and seed production tends to be somewhat lower.

Our initial selections were made from a field that had been in pasture for 15 years. These plants had been under intense competition, as the sward consisted chiefly of orchardgrass, red top and Kentucky bluegrass. Thirty-seven of the plants that we obtained provided sufficient cuttings for a replicated greenhouse trial to evaluate tillering and aftermath production. From the results of four cuts taken at monthly intervals, we retained ten lines for further evaluation in the field. Three of these were discarded later for lack of vigor; the others were cloned again for planting in a replicated field trial in plots using a grid system of planting with a one-foot interval between plants. The check or control plots consisted of clones (parental strains) from one plant of Climax.

The first cut in the year after establishment, taken on June 5, 1962, was followed by a hot, dry period. Many plants in some lines died during this period while in other lines there was little or no loss of plants and good aftermath recovery (Fig. 2). The total aftermath yield from two cuts, July and October, varied from 564 pounds per acre for the check to 4927 pounds per acre for the highest producing line.

Mr. Folkins specializes in forage crop physiology and management and Dr. Childers is a plant breeder and Chief, Forage Crops Section, CDA Research Station, Ottawa, Ontario.

Fig. 1—Left to right: Plants of Climax, Line 5 and Line 9 show differences in growth type.

Fig. 2—Differential recovery following cutting on check plots (left) and Line 9 (right).

CHAMP TIMOTHY

DEVELOPMENT OF A HIGH AFTERMATH VARIETY

In another trial established at the same time, we compared two of the better lines with the check, under hay and pasture management systems. The two lines were significantly superior to the check in aftermath production under both systems.

In the next step of the evaluation program, we tested five lines and Climax in rows one foot apart in plots. The average yield of the five lines is compared with the yield of Climax in Table 1. All lines were equal or superior to Climax in first cut yield and were generally higher in aftermath production. The major advantage in aftermath production occurred in the third cut; all lines were significantly higher yielding than Climax in 1963 and all except one in 1964.

On the basis of results from these trials, we combined Lines 2, 5, 6 and 9 as a synthetic and sent seed from the synthetic to various stations across Canada for comparative evaluation. The intensive testing program has produced results at research stations from coast to coast. The total seasonal yield for three varieties at locations where two or more cuts were harvested is given in Table 2. The aftermath yield of Champ and Drummond in relation to the yield of Climax in 1966 is shown in Fig. 3.

The evaluation program has shown that this variety is promising as a high yielding, higher aftermath type of timothy and there are indications of better persistence under close clipping and adverse weather conditions.

Seed is not yet available commercially, but the supply is being increased. Seed was harvested in 1968 from fields established in 1967 from 500 pounds of Breeder seed distributed by the Canadian Forage Seed Project. In addition, there are 700 pounds of Breeder seed and 3100 pounds of Foundation seed on hand, mostly from the 1967 crop, that will be seeded for further increase. There should be a fairly abundant supply of Certified seed by 1970. ■

Fig. 3—Relative yield of aftermath of three timothy varieties in 1966. (Climax = 100%) (Stations 1-3: Atlantic Provinces; 4-12: Quebec and Ontario; 13-17: Western Canada.)

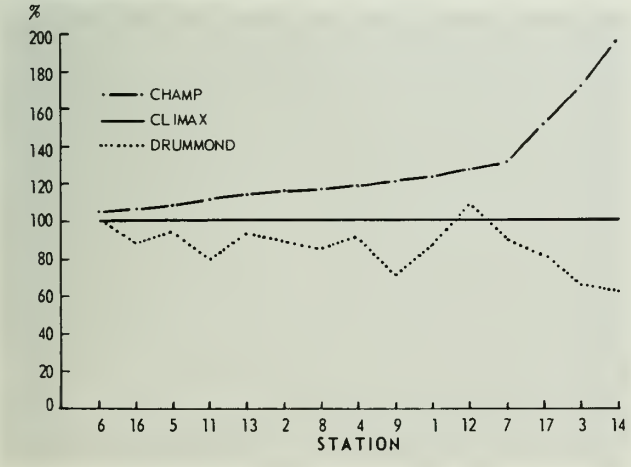


TABLE 1. AVERAGE YIELD OF DRY MATTER (lb/A) OF FIVE SELECTED LINES AND CLIMAX (1963-64 average)

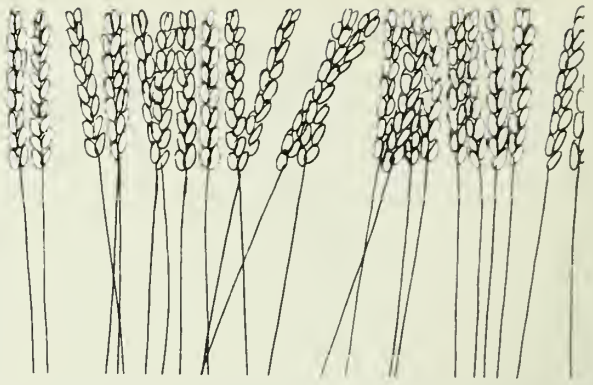
	Cut 1	Cut 2	Cut 3	Total
Selections	3313	935	1819	6067
Climax	3168	1053	1501	5722

TABLE 2. AVERAGE SEASONAL YIELD OF THREE TIMOTHY VARIETIES

	First Harvest Year		Second Harvest Year
Variety	1965 (9)[1]	1966 (9)[1]	1966 (6)[1]
Climax	7942	7576	7429
Champ	8258	7692	7458
Drummond	7005	6964	6966

[1] Number of stations in average.

REDUCE THE GAMBLE IN WHEAT PRODUCTION



P. J. JANSEN

Advancing technology has improved efficiency of moisture use to make possible production of near-average crop yields when precipitation is below normal.

Precipitation has long been recognized as a key limiting factor on crop yields in the semiarid areas of western Canada. Over a period of years in southwestern Saskatchewan, the relationship between crop year precipitation and yield of wheat on fallow has changed. The extent of this change shows how progress through technology has increased the production of wheat under conditions of limited rainfall.

Studies on the relationship between precipitation and yield have been conducted at the Swift Current Research Station since 1923 and at the Project Farms at Bracken, Gravelbourg and Tugaske since their inception. The relationship between crop-year precipitation and yield of wheat followed a similar pattern at all locations. But we have selected data from only Swift Current and Bracken for this article.

Crop production in southwestern Saskatchewan is carried out mainly in a two-year rotation of fallow-crop. It is obvious, therefore, that precipitation during the fallow year will have a direct effect on the yield of grain the next year. It can also have both a direct and indirect effect on subsequent crops.

Annual precipitation is quite erratic but there is a tendency for the precipitation to be cyclic with alternating periods of wet and dry years. As a result, precipitation has a cumulative effect on crop production over a period of years. Therefore, the effect of precipitation on crop yield can best be measured by comparing the average precipitation over a period of years with the average yield over a similar period. For our purposes here the data on yield and precipitation and the moisture efficiency (bushels of wheat per acre per inch of precipitation) have been summarized on the basis of a five-year moving average and are presented in Figs. 1 and 2.

The data from Swift Current (Fig. 1) show that the longtime average yield of wheat on fallow at this location was 19.6 bushels per acre and the average crop-year precipitation was 13.5 inches, An analysis of the data shows that the general trend has been for the five-year average yields to increase quite noticeably over the years while the trend in the five-year average crop-year precipitation shows only a slight upward trend. At Bracken (Fig. 2) the longtime average yield of wheat was 16.2 bushels per acre with an average crop year precipitation of 12.5 inches. The general trend of the five-year average yields shows yields have been increasing while the trend in crop-year precipitation shows a definite decline in precipitation over the years.

The trend toward increased yields is further illustrated by the graphs on efficiency of moisture use. (Data for these graphs were obtained by dividing the five-year average yields of wheat by the five-year average precipitation). The trend line shows that the yield of wheat per acre per inch of precipitation increased from 1.1 to 1.7 bushels at Swift Current and from 1.0 to 1.5 bushels at Bracken.

A further study of the graphs shows that the increase in yields over the years was more marked between periods of below average precipitation than between periods of above average precipitation. At Swift Current thc five-year average yields droppde below 10 bushels per acre in the 1930's while the lowest five-year average yield in the 1960's was 19.6 bushels per acre under similar amounts of precipitation. At Bracken, while the average precipitation was somewhat higher in the 1940's than in the 1960's, the average yields were increased from a low of 6.2 bushels in the former period to a low of 12.4 bushels per acre in the latter period.

The above discussion indicates there has been a gradual improvement in the efficiency of moisture use. The major factor responsible probably is the adoption of newer techniques developed over a period of years which have greatly improved crop production, especially under conditions of limited precipitation. In other words, technology has made it possible to produce near average crop yields under conditions of precipitation which would have resulted in almost complete crop failures some twenty to thirty years ago.

Research conducted at the Swift Current Research Station during thc 1920's and 1930's showed that

The author is an agronomist at the CDA Research Station, Swift Current, Sask.

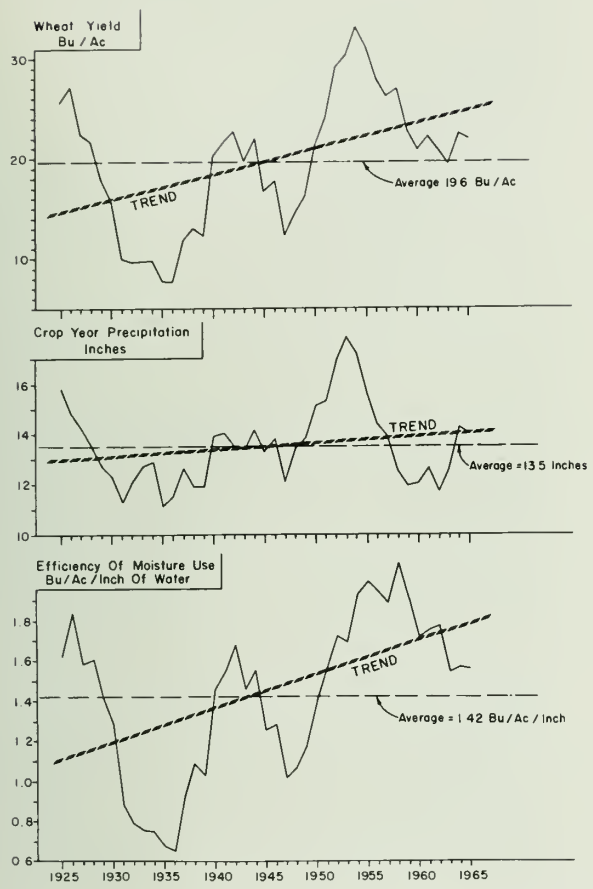


Fig. 1—Showing the five-year moving averages and trend of yields of wheat on fallow, crop year precipitation and bushels per inch of precipitation at the Swift Current Research Station.

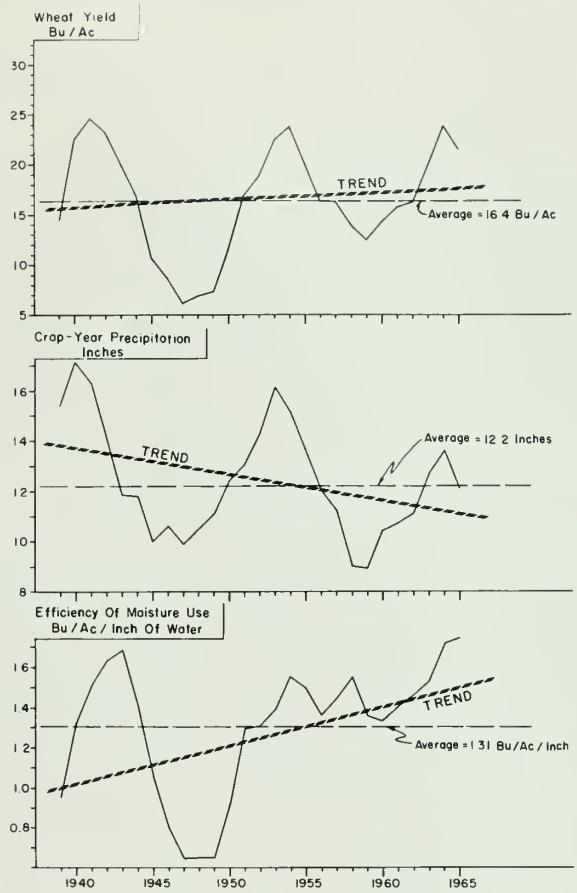


Fig. 2—Showing the five-year moving averages and trend of yield of wheat on fallow, crop year precipitation and bushels per inch of precipitation at the Project Farm, Bracken, Sask.

moisture conservation was a major factor in crop production in this area. It showed also that the control of weeds was essential in moisture conservation. With the limited power and equipment available at that time, it was practically impossible to get all the field work done at the best time, and only partial weed control was obtained.

Immediately after World War II there was a rapid development of larger power units and heavier and wider equipment. This made it possible to do a more thorough job of tillage in a shorter time. It also made it possible to prepare and seed more land during the optimum period for these operations.

The use of chemicals like 2,4-D for weed control in crops was introduced in 1948 and soon became widely adopted. This, in itself, has made a considerable difference in crop yields.

Experiments conducted at this Station and at the Project Farms in the area during the late 1940's and through most of the 1950's showed that controlling weeds at a very early stage of development, working some of the land to be fallowed before undertaking seeding operations, produced maximum moisture conservation. Further, that careful tillage during the summerfallow period so as to prepare a firm seedbed for the following spring made it possible to do a much better job of seeding, thus resulting in more uniform crops.

The importance of adjusting tillage operations to meet local soil conditions is best illustrated by the results obtained at Bracken. The soil is a mixture of Echo and Haverhill clay loam. It is difficult to work and tends to bake hard when dry. Because of the power required to work the land and the low yields that were obtained, the land was originally worked quite shallowly with a minimum number of tillage operations. Results of tests indicated that this soil required intensive cultivation to obtain maximum production. With larger power units and heavier equipment it was possible to change to more intensive cultivation, with results as shown in Figure 2.

Other factors which have helped increase yields over the years are the introduction of rust and sawfly resistant varieties of wheat and chemicals for insect control.

In conclusion, it can be said that each of the above factors contributed to the increased yields obtained. However, maximum production will only be obtained by keeping in close contact with the latest developments in the agricultural field, assessing their suitability, and then testing them to see how they can best be adapted to local conditions. ■

ORCHARD MITES

R. S. DOWNING

Two of the major pests in the fruit growing areas of British Columbia are the European red mite and the McDaniel spider mite. These mites can cause extensive injury to leaves resulting in reduced size and quality of crop. In many orchards one to five sprays are required to control. Because resistant strains of mites have developed to most miticides, control has become more difficult and spray costs have increased.

We have been conducting studies at the CDA Research Station, Summerland, B.C. to determine if mite predators can control these mites. In orchards where no insect or mite sprays were applied for several years, we found that predaceous mites increased and reduced the European red mite on McIntosh and Spartan apple trees, but not on Red Delicious. The McDaniel spider mite was controlled by the predaceous mites on these three varieties.

Since these predators are not capable of controlling the European red mite on all varieties, it was necessary to find a miticide that would control the European red mite and allow the predaceous mites to survive and feed upon McDaniel spider mites. Our studies revealed that certain petroleum oils, endosulfan, and some experimental compounds had this desired selectivity.

In commercial orchards, predaceous mites have increased in recent years. It seems probable that the mite has developed strains that are resistant to the organophosphorous compounds used for codling moth control. Previously, these insecticides were so toxic to the predaceous mite that very few survived after one application.

The information obtained in the non-sprayed orchards was given a practical test over the past two years by integrating chemical and biological control in several British Columbia orchards where predaceous mites were present. Selective mite sprays were applied in the pre-bloom period of apple bud development to assist in the control of the European red mite. Sprays to control other pests were applied as necessary but, where possible, preference was given to sprays that were comparatively non-toxic to predaceous mites.

In 1967, the predaceous mites reached a high density in six out of the ten test orchards and no summer miticides were necessary. In three of the orchards, the predators did not increase sufficiently and summer miticides to control either European red mite or McDaniel spider mite were applied. In a fourth orchard, control of the European red mite was poor and a spray had to be applied in spite of a

The author specializes in insecticides and mites in the Entomology Section, CDA Research Station, Summerland, B.C.

INTEGRATED CONTROL OF FRUIT TRE

high density of predatory mites. Our observations in integrated control orchards revealed the following:

(1) It is necessary to supplement control of the European red mite by a spray of petroleum oil or a mixture of oil and ethion, applied at the half-inch green bud stage. Ethion can be used only if the predaceous mites are resistant to organophosphorous insecticides.

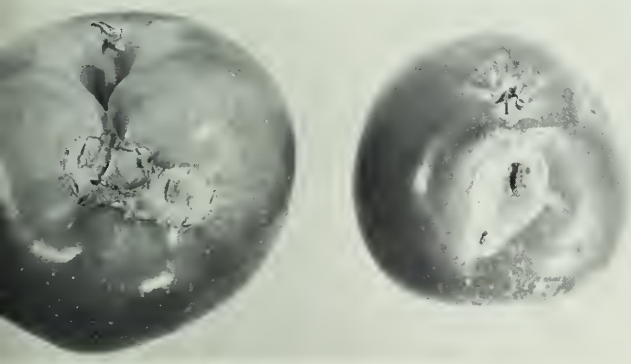
(2) The thinning spray of carbaryl (Sevin) is exceedingly toxic to the predaceous mites. Other thinning sprays such as dinitro ortho cresol or napthalene acetamide are comparatively non-toxic to the predaceous mites and should be given preference.

(3) The miticides, dicofol and binapacryl, are particularly toxic to predaceous mites.

(4) In some orchards the predaceous mites are resistant to the recommended organophosphorous insecticides.

We found it important to make frequent observations in these integrated control orchards. Initially, leaf samples were taken once every two weeks but this was changed to once a week when mite densities rose. It is essential that the person making the observations has the knowledge to recognize predaceous mites and to distinguish them from phytophagous mites. He should also be familiar with the seasonal development of these mites. The decision to omit sprays must be based on a sound knowledge of the pest and predator balance in the orchard.

Fruit-tree leafroller injury to McIntosh apples.



PESTS

ORCHARD INSECTS

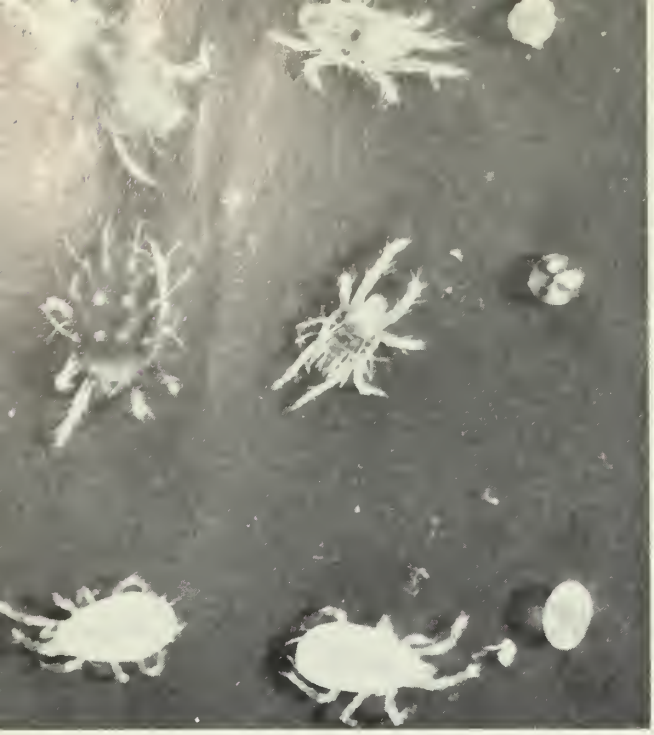
HAROLD F. MADSEN

In the last two years, a good deal of publicity has been given to methods of control which are non-chemical or that minimize the use of pesticides. One of these is control of the codling moth by the sterility method. Another is integrated control of the McDaniel mite which depends upon the action of predatory mites. Both of these approaches are interrelated, as the elimination of codling sprays will permit the survival of predatory mites in addition to predators such as mirid bugs, anthocorids, lacewings and lady beetles.

But what of the pests which have been held under control by the codling moth spray program? Will insects such as the fruit-tree leafroller become so injurious that we will be forced to spray as often as was necessary for codling moth control? Partial answers to the above questions have been obtained by the entomologists at the CDA Research Station, Summerland, B.C. through studies in an orchard where codling moth sprays have been omitted for six years. The mite predators have increased in this orchard and have controlled the European red mite, apple rust mite, and the McDaniel mite. However, the fruit-tree leafroller, eye-spotted bud moth and white apple leafhopper have increased to damaging numbers. In 1967, we started a program to control these insects without adverse effects against the mite predators and without using chemicals or applications that would interfere with the release of sterile codling moths.

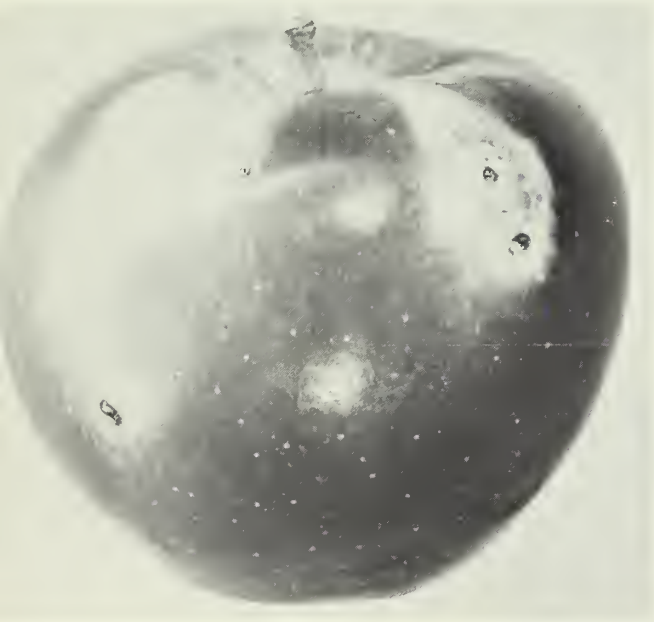
A logical time of application was the pre-bloom period, because codling moths have not emerged, and predator mites are in protected overwintering sites. Plots were established in the experimental orchard on three apple varieties, Red Delicious, McIntosh, and Spartan. The materials used, time of application, and rates per acre were as follows: Dormant oil, 6 and 8 gal. at the ½ inch green stage; dormant oil 6 gal. at the ½ inch green stage followed

Dr. Madsen is Head of the Entomology Section, CDA Research Station, Summerland, B.C.



From left, top to bottom: 1 Predaceaous mite—two females, egg; 2 European red mite—female, male, egg; 3 McDaniel spider mite—female, male, egg.

Eye spotted bud moth injury to Spartan apple.



by Guthion 25% wettable powder 2½ lb. at the pink stage; Guthion 25% wettable powder 5 and 2½ lb. and Guthion 2½ lb. plus dormant oil 5 gal. at the pink stage.

We evaluated the results by counting infested fruit bud clusters after bloom and by examining the apple at harvest. Leaf counts of both phytophagous mites and predator mites were made during the growing season to determine the effect of the treatments on mite control.

Excellent control of the fruit-tree leafroller and eye-spotted bud moth was obtained with Guthion at 2½ and 5 lb. per acre and the combination of oil and Guthion. The dormant oils alone did not provide acceptable control. Oil at 6 gal. per acre and Guthion at 2½ lb. did not reduce predator mites over the untreated check. Oil at 8 gal., Guthion at 5 lb. and Guthion plus oil were toxic to the predators, and both McDaniel mite and European red mite increased on the trees in this treatment. None of the sprays had any effect upon the white apple leafhopper, and infestations were high on both treated and check trees.

These results indicate that Guthion at the rate of 2½ lb. 25% wettable powder can be used to control eye-spotted bud moth and fruit-tree leafroller if applied at the pink bud stage of tree development. This rate of Guthion is not toxic to mite predators and the timing is too early to interfere with the release of sterile codling moths. In all probability, this early spray will also control the green fruit worm as well as other leaf feeding insects which are active early in the season.

Since the white apple leafhopper overwinters as an egg beneath the bark and does not hatch until bloom, post-bloom sprays are necessary to control it. Recent studies have shown that endosulfan applied at the petal fall stage will control leafhoppers without adversely affecting beneficial insects and mites. Although the material is toxic to codling moth it is not persistent and at the dosage used should not present a hazard to the sterile codling moth release program.

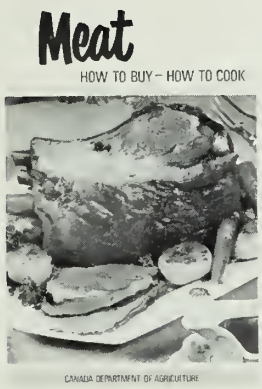
The data obtained indicates that we can control pests that might become troublesome when codling moths sprays are eliminated. And more important, they can be controlled without destroying natural ennemies of mites and other tree fruit pests. ■

PUBLICATIONS

Copies of these, and a list of other publications may be obtained free of charge (unless otherwise stated) from: Information Division, Canada Department of Agriculture, Ottawa.

On peut obtenir gratuitement (à moins d'avis contraire) des exemplaires de ces publications ainsi qu'une liste d'autres publications à: la Division de l'information, ministère de l'Agriculture du Canada, Ottawa.

971 MEAT: HOW TO BUY—HOW TO COOK. 80 pp. An updated version of a very popular book. New recipes are included. Available from Canadian Government bookshops or by mail from the Queen's Printer, Ottawa. $1.00

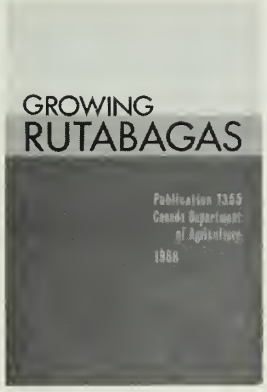


971 LA VIANDE: ACHAT—CUISSON. 80 pages. Version renouvelée d'un livre très populaire. On y trouve de nouvelles recettes. Disponible aux librairies du Gouvernement canadien, ou par commande postale à l'Imprimeur de la Reine, Ottawa. Prix: $1.

1277 PROBLEM FEEDS FOR LIVESTOCK AND POULTRY. 20 pp. Mouldy, frosted or burned grain can be safely fed to livestock provided certain precautions are followed.

1277 ALIMENTS DOUTEUX POUR LES BESTIAUX ET LES VOLAILLES. 20 pages. On peut utiliser sans danger, pour l'alimentation du bétail, les céréales moisies, gelées ou brûlées en prenant certaines précautions.

1355 GROWING RUTABAGAS: 8 pp. Primarily for the commercial grower, this publication covers all aspects of growing, insect control, storage etc.



1355 LA CULTURE DU RUTABAGA. 8 pages. Destinée surtout au producteur commercial, cette publication couvre tous les aspects de la croissance, de la répression des insectes, de l'entreposage, etc.

1337 HOW TO BUILD A PLASTIC CROP SHELTER OR GREENHOUSE. 16 pp. Plans and specifications for a portable plastic crop shelter.

1140 SQUASH AND PUMPKIN. 4 pp. Nine recipes for the preparation of Canadian grown squash and pumpkins.

1357 CULTURES HYDROPONIQUES OU SANS SOL. 8 pages. Esquisse des principes et méthodes de culture des plantes dans du sable ou de l'eau.

1357 SOILLESS GROWTH OR HYDROPONICS. 8 pp. An outline of the principles and practices involved in growing plants in water or sand.

1337 CONSTRUCTION D'UNE SERRE EN PLASTIQUE. 16 pages. Plans et devis pour un abri transportable en plastique.

1140 COURGE ET CITROUILLE. 4 pages. Neuf recettes pour la préparation de courges et citrouilles produites au Canada.

CANADA AGRICULTURE